REPORT RESUMES

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PLANNING FOR A READING RESEARCH PROGRAM.
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NEW MATERIALS, METHODS, AND RESEARCHERS WERE ASSEMBLED TO PROVIDE A RESEARCH-BASED MODEL FOR A NEW CURRICULUM IN THE TEACHING OF READING. PROCEDURAL METHODS, THE INTERRELATED FUNCTIONS, AND BASES OF READING-LEARNING WERE DISCUSSED IN A SERIES OF FOUR RESEARCH PLANNING CONFERENCES. ANALYSES AND RECOMMENDATIONS OF ALL THE STUDIES INITIATED HAVE NOT BEEN COMPLETED. CONTINUED RESEARCH WILL PROVIDE NEW INTEREST FOR RESEARCHERS IN THE FIELD AND A CONTINUING POSSIBILITY FOR CURRICULUM IMPLEMENTATION. (PM)

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PLANNING FOR A READING RESEARCH PROGRAM

Cooperative Research Project No. F-034

Harry Levin

Cornell University

Ithaca, New York

1965

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OBJECTIVES OF PROJECT LITERACY

The purpose of Project Literacy is to organize, in various universities, laboratories and state departments of education, research which is essential to understand the acquisition of reading skills. The major initial effort was to bring together researchers and educators from a variety of disciplines to plan research which, when taken as a whole, would give us more substantial results than any single study can provide. Each investigator in the consortium of researchers is completely responsible for his own research activities. The project provides mechanisms whereby the individual scientists can communicate their research strategies, problems and results to each other. One of these is Project Literacy Reports, an irregularly issued bulletin for the communication of research plans and results. When called upon, Project Literacy has provided technical research consultation. In addition the group at Cornell University has undertaken a program of studies similar to those which are being initiated in other settings.

We believe that much current and potential research in learning psychology, visual perception, cognitive behavior, neurophysiology of vision, child development, descriptive linguistics, psycholinguistics, the sociology of educational innovation, research with culturally disadvantaged children and programmed instruction (to cite some examples) are essential to understanding literacy. Consequently, we have endeavored to locate research interests which heretofore may not have been considered relevant to this crucial educational research area.

More specifically the aims of Project Literacy have been the following:

1. To instigate basic and applied research on topics which directly or indirectly will increase our knowledge of the process of learning to read.
2. To bring these findings to bear on the development of materials and methods for instruction in reading.
3. To involve in research those productive investigators who have not heretofore worked on education-related problems but whose research indicate their potential contributions to understanding the reading process.
4. To attract talented younger scientists and graduate students to educational research.
5. To provide a model of research based curriculum which may have implications for curriculum development in various content areas.

Approximately seventy researchers from twenty-five different universities and research centers have attended four research planning conferences conducted by Project Literacy. The conferences focused on the following topics: the psychological bases of reading skills, linguistic and psycholinguistic disciplines and their relationships to reading, motivational and sociological factors in reading, and curriculum development and techniques of instruction. Specific plans for research have been formulated by many of the conferees. In many instances plans for collaborative research have grown out of the discussions and graduate students have been inspired to undertake research which meshed with the work in other laboratories. A major task of Project Literacy is to maintain this affiliation among researchers and to bring their coordinated efforts to fruition in curriculum revision.

The acquisition of initial literacy has been intensively observed in an experimental first grade class by a psychologist and a linguist. This classroom and others will be facilities where research findings will be tried out. During the summers of 1965 and 1966 affiliates of Project Literacy together with experienced teachers will participate in curriculum writing seminars. This curriculum will be tested in classrooms in the academic year following the seminar. The results of these tryouts and the accumulation of new research findings will eventuate in a large scale curriculum development and testing program. The criteria of Project Literacy's success will be the development of curricula and instructional procedures for teaching children and adults to read.

The Steering Committee of Project Literacy besides the director includes:

Professor Roger Brown, Department of Social Relations
Harvard University

Professor Jeanne Chall, City College of the City
University of New York

Professor Charles F. Hockett, Departments of Anthropology & Linguistics
Cornell University

Professor Patrick Suppes, Instit. for Mathematical Studies in
the Social Sciences
Stanford University

REPORT OF THE

FIRST RESEARCH PLANNING CONFERENCE

"THE PSYCHOLOGICAL BASES OF READING SKILLS"

Held Under the Auspices of

Project Literacy

in

Dedham, Massachusetts

June, 1964

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WHAT IS PROJECT LITERACY?

Project Literacy was organized at Cornell University on February 1, 1964, by a developmental projects award from the Cooperative Research Branch of the United States Office of Education. This project represents one of the major commitments of the Office of Education to basic research and curriculum development concerning both child and adult literacy.

The purpose of Project Literacy is to organize, in various universities, laboratories and State departments of education, research which is essential to understanding the acquisition of reading skills. The major initial effort is to bring together researchers and educators from a variety of disciplines to plan research which, when taken as a whole, will give us more substantial results than any single study can provide. Each investigator in the research consortium will be completely responsible for his own research activities. The project will provide mechanisms whereby the individual scientists can communicate their research strategies, problems and results to each other and when necessary they will be able to meet together. When called upon, Project Literacy can provide technical research consultation. The Project will facilitate the translation of research findings into classroom practices and materials. The group at Cornell will also undertake a program of studies similar to those which will be initiated in other settings.

We believe that much current and potential research in learning psychology, visual perception, cognitive behavior, neurophysiology of vision, child development, descriptive linguistics, psycholinguistics, the sociology of educational innovation, research with culturally disadvantaged children and programmed instruction (to cite some examples) are essential to understanding literacy. Consequently, we are endeavoring to locate research interests which heretofore may not have been considered relevant to this crucial educational research area.

The first research planning conference under the auspices of Project Literacy was held at MIT Endicott House, Dedham, Massachusetts, June 17-19. Eleven psychologists from universities and their graduate students took part. Each researcher presented a research proposal which was discussed by the group. Brief summaries of each proposal are given in this, the first issue of Project Literacy Reports. More detailed versions of his research plans may be available from each participant.

AROUSAL: IMPLICATIONS FOR A LEARNING-TO-READ PARADIGM

Yvonne Brackbill
University of Denver

For the last four years, this laboratory had been concerned with a project investigating the effects on retention of reinforcement delay during learning. In more than a dozen experiments with young children working under a variety of conditions, it has been found consistently that reinforcement delay facilitates retention. For the sake of brevity, this phenomenon has been called the delay-retention effect.

In trying to find the reason for the occurrence of the delay-retention effect—i.e., the improvement of retention via reinforcement delay during learning—we have been led to formulate a general hypothesis of retention. The hypothesis is this: any condition that increases arousal during learning will improve retention of the learned material. Arousal is defined, in a loose-jointed conceptual way, as increased attention to a non-threatening stimulus, and in an operational sense, as a definite response pattern in recordings of heart rate, GSR, and possibly, blood volume. One condition that increases arousal appears to be reinforcement delay during learning. Another condition may well be the level of difficulty of the learning task. If valid, the hypothesized relationship of both these factors to arousal, and the relation of arousal to retention (and to learning?) should be extremely important factors for the learning-to-read and learning-to-write situations.

The main objectives of the studies proposed at the conference are as follows: (1) to compare the relative merits of three indices of arousal—heart rate, GSR, and blood volume—and to confirm or deny the hypothesis that reinforcement delay and task difficulty are directly related to level of arousal, which in turn influences retention; and (2) to determine which of the stimulus combinations available to a teacher maximizes short-term and long-term retention of learned grapheme-phoneme associations. As an example, the plan of the second experiment is given below.

The relative effectiveness of stimulus combinations in establishing grapheme-phoneme associations.

The usual approaches to teaching a child to read can profitably be viewed as embodying a great deal of paired-associate learning. The experimental design, in Table 1, is proposed as a starting point for investigation of the process. The stimulus will be the written word alone, or in combination with either or both spoken word and pictured object. All Ss will be given the same fixed number of presentations of the stimuli, and for the Ss the response will be the spoken word. Knowledge of results (the correct spoken word) and, if necessary, a token reward, will serve as reinforcement. Physiological measures will be recorded, as in the preliminary study, except that in this study half the Ss under each condition will be run without attached electrodes, as controls for possible effects of electrode attachment on learning and retention.

Table 1. Design of acquisition phase of Experiment II. N is not less than 12/cell

	Groups	Stimulus, training condition	Response
Physiological measures taken	1	Grapheme	Phoneme
	2	Grapheme + phoneme	Phoneme
	3	Grapheme + object	Phoneme
	4	Grapheme + phoneme + object	Phoneme
No physiological measures taken	5	Grapheme	Phoneme
	6	Grapheme + phoneme	Phoneme
	7	Grapheme + object	Phoneme
	8	Grapheme + phoneme + object	Phoneme

Following acquisition, the eight groups will be further subdivided according to length of time intervening between learning and tests of retention. It is proposed that both short-term and long-term measures of retention be taken—probably one day, and one week, after acquisition.

During the retention session, one unreinforced presentation of the list will be given, asking for recall of the spoken words. Then, successive reinforced runs through the list will be given, to a criterion of relearning. Results will indicate which manner of stimulus presentation maximizes retention of the grapheme-phoneme association.

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ACQUIRED RELEVANCE OF CUES IN READING: THE LEARNING OF SELECTIVE OBSERVING RESPONSES

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The research that I have been pursuing for the past year or so is concerned with how young children learn to process information. In collaboration with Miss Zahn and other students I have been trying to analyze experimentally some of the mechanisms by which children learn what aspects of the stimulus situation are relevant to the solution of the problem at hand, whether it be a simple simultaneous two-choice discrimination or a complex array of ten alternatives yielding only partial reinforcement. We are approaching the problem from two different directions at once. One is the study of search behavior as it is organized in long sequences of responses during problem solving. The other is the study of observing responses in discrimination learning.

Problem solving and search behavior. Starting with the assumption that trial and error behavior is more than the natural selection of certain responses by reinforcement and the extinction of other by nonreinforcement, we have focussed on rather complex and ambiguous tasks, wherein we can study the ways in which children organize and systematize their search for a solution. We have been able to distinguish patterns and sequences of responses that are hypotheses in the process of being tested, from similar patterns that are being used as search routines by S. Systematic search is, we believe, more than just a style of approaching problems. It is a specific, organized sequence of information-producing and record-keeping behaviors that can be taught as a general strategy of approaching complex problems.

Organization of observing behavior. On a much more direct and primitive level orienting and observing behavior seems to have many of the same functional properties as does systematic search in problem solving. In both cases random querying of the environment seems to give way by age six or seven to orgaized investigation. In both cases there is a continuing interplay between, on the one hand, looking around, playing hunches, guessing, etc., and on the other hand, deliberate, sequentially organized, internally coherent looking and testing. We believe that the major function and value of both systematic search and orderly perceptual comparison is to discover what particular cues are really relevant to the problem at hand. Once the child has discovered which cues are relevant and has by his own active comparison and ordering responses outlined the reasonable possibilities for a correct response, then the process of learning any correct stimulus-response pairing is simple, rapid, and quite stable. To this end we have been studying eye and hand movements in visual and tactual discrimination learning of children.

Rather than simply photographing natural eye movements, we have devised an apparatus on which children learn to operate a level to bring either of two stimuli into focus. Thus both stimuli are continuously available but out of focus, and it takes a combination of explicit, voluntary observing responses to compare them. Working with third-graders Miss Zahn has employed a delayed reinforcement design in which all subjects must operate the lever to compare the stimuli before choosing on each trial, but also in some conditions they are permitted to continue comparing the stimuli which waiting to find out whether their choice was correct or not. Those who have the additional practice with this relevant orienting behavior not only learn quicker, but also look longer before choosing. Moreover, their more careful comparing of the stimuli continues unabated for some time after they have achieved the learning criterion. Those not permitted to practice observing and comparing during the delay interval learn more slowly, make fewer and briefer comparisons, and show decreases in frequency and duration of looking responses over trials before they have learned the discrimination.

Application to the study of learning to read. Teachers have long known that attention is one key prerequisite to learning. Our aim will be to take apart the variable of attention as it is revealed in selective and organized looking behavior in children learning to read. We hope to bring the observing behavior itself under experimental control by pre-training and then to use the observing behavior in a variety of situations where it interacts with discrimination of graphemes, acquisition of grapheme-phoneme correspondences, and whole word recognition. We plan to make heavy use of the work already accomplished by others on the critical features of letters and words. We shall be especially interested in optimizing the time relations among observational interval, response latency, frequency and duration of looking, feedback, and rehearsal of correct responses following positive and negative reinforcement. We shall attempt also to investiage the effects, both facilitating and interfering, of pre-training relevant and irrelevant observing responses.

On the side of problem solving our attention will be directed toward the influence of success and failure (levels of noncontingent reward) on guessing as opposed to systematic analysis in learning an artificial language of grapheme-phoneme correspondences. The latter research is at this time only in the discussion stage, and our plans are tentative at best.

SYSTEMATIC INVESTIGATION OF CERTAIN VARIABLES BASIC TO THE DEVELOPMENT OF EFFECTIVE INSTRUCTIONAL SEQUENCES IN READING

Joanna P. Williams
University of Pennsylvania

The primary need in reading research today is for a very careful and systematic analysis of what "reading" really is. Only after the general task has been analyzed into its components will serious advances in instruction be made. As each component skill is defined and isolated, strategies for training must be developed and assessed. While optimal training sequences may perhaps turn out to involve integrated training on several component skills at the same time, it seems reasonable to expect that the initial steps will come from investigations of each component skill considered separately.

Specification of the task components is a job in itself. For example, one of the most fundamental skills in reading is the ability to "sound out" novel grapheme combinations. Some of the components here include phoneme differentiation, phoneme blending, grapheme discrimination, associative learning of individual graphemes and phonemes (or combinations), learning to follow a left to right sequence, and transferring previously learned correspondences to novel combinations.

There are several research strategies which can be employed ranging from theoretical approaches such as that of Gibson (e.g., her set of distinctive features for graphemes) to those involving the development of an instructional sequence via "good guesses", making successive approximations toward the most effective program possible. Regardless of one's strategy, however, systematic data on basic variables in the specific context of the actual materials we wish to teach will be useful.

Listed here are several fundamental questions to be considered in choosing the order in which to introduce letters and letter combinations.

1. Following standard programmed instruction principles, should the task start off as a very simple one, and gradually increase in difficulty?
    (a) Should there be "maximum contrast" between the items presented initially, and then a gradual decrease in contrast? For example, should the child learn to discriminate the graphemes o and t before he is presented with b and d?
    (b) Is it more important that the graphemes or the phonemes be well-differentiated? In general, pre-differentiation and familiarization training on the response side proves more effective. Does this principle hold for these specific materials? If so, then perhaps sequences should be designed so that the phonemes are maximally contrasted at first (i.e., u vs. n would be presented much earlier than b vs. p).
2. How much of the material should be presented at one time? This, of course, is the classic issue of whole vs. part learning, recently revived by Suppes.
3. What performance level should be attained before going on to the next task in the training sequence? Should there be training on each item, or on each component, until a very high criterion is reached (e.g., Fries' "automatic habits")? Or, on the other hand, should the training program move along so that S never is thoroughly competent and confidental at any one state (as recommended, for example, by O. K. Moore)?

The following experiment is suggested as a starting point:

Pretraining: Each subject (kindergarten age) will be pre-trained at one combination of levels of these two factors:

1. Predifferentiation of the phoneme combinations (responses): None, Low and High levels of training, the highest of which will produce substantial overtraining on this task.
2. Predifferentiation of the grapheme combinations (stimuli): Three levels as above.

Training: A list of simple 1:1 grapheme-phoneme correspondences (combinations) will be learned. A constant number of anticipation trials (experimenter-paced) will be given, on which S will be required to pronounce the phoneme combination when the grapheme combination is presented.

Both acquisition and retention will be studied. Will the results differ as a function of the amount of training given on the correspondences? Errors will also be analyzed, in order to determine whether particular kinds of errors tend to be made as a function of pretraining condition. The efficiency of teach training condition will also be assessed.

If the results prove interesting, the experiment might be extended to include other list lengths, as an initial step in studying the amount of material parameter.

Effect of Consecutive Vs. Concurrent Presentation on the Association of two Verbal Responses with a Single Referent

I. Background

A. Grapheme-phoneme correspondences

1. Bloomfield recommends that only one correspondence should be taught at a time; only after a high learning criterion has been reached should another phoneme associated with that grapheme be introduced.

2. Levin argues that both correspondences should be developed at the same time and has data to support his diversity hypothesis.

B. Second-language learning

1. "Naturalistic" observations such as Leopold's suggest that children who learn two languages concurrently experience confusion.

2. Recent experiments by Levin and by Singer, on the other hand, indicate that concurrent training is more effective.

II. Research Plan

A. Subjects: fourth grade children

B. Modification of previous studies: Materials will reflect more clearly the natural situation, e.g., meaningful stimuli (pictures of common, familiar objects) will be used.

C. Additional variables

1. Did the cue that indicated the "language" to which each response term belong influence the results? Groups run with such a cue and with no cue will be compared. (If the cue-present condition produces superior results, the suggestion might be made that children being trained in two languages should hear each language consistently from the same people, etc.)

2. In the consecutive training, the degree of proficiency on the first language before the second language is introduced will be varied. A high level of proficiency before switching will probably lead to greater differentiation and isolation of the two response sets, and may increase the effectiveness of consecutive training as compared with concurrent training.

READING AS A MOTOR SKILL: A MEDIATION MODEL

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The five studies proposed share a common conceptual framework. In this framework, which is based on a mediational model of learning, the process of learning to read is conceptualized as a motor skill which develops through several stages of integration until a final neural analogue is established. In this conceptualization, the preliminary stages of learning to read are linked closely with a set of sounds that are the auditory counterpart of what is initially a perceived object. The next stage of development is forming the link that occurs with seeing pictures with this sound, and as a final preliminary stage, developing the relationship between a set of symbols, a picture, the object itself and the set of sounds.

In this model, next to the object itself, the sounds provide the richest and most constant source of stimulus support extending over the entire range of stimuli to which the identifying response is generalized. This offers in many ways a more solid base for generalization than the original object. Consequently, it would seem that the vocalization of sounds associated with learning objects and concepts provides the richest constant source of stimulus support during the early stages of association and generalization.

The preliminary stages in this model refer to those periods when the child (1) has learned by rote, a set of symbols associated with a story that has been read to him many times; (2) has begun to learn these symbols by himself but uses the sounds as a reference or resource in checking himself on the meaning of a set of symbols.

Once the above preliminary stages have been mastered, the overt vocalization which has been preeminent until now is replaced by another stage of integration in which the gross vocal movements drop out to be replaced by subvocalizations or vocalizations far below the normal conversational level. This pattern is present during the stages when the initial elements of the task of learning to read have been mastered but the elements of skill and speed are as yet undeveloped. Once the level of integration of the reading response has reached a certain level, the subvocalization disappears, to be replaced by a neural analogue of this process which allows a high level of skill and speed. Steps in developing this neural analogue in certain ways parallels the original process and perhaps is isomorphic to the motor development pattern. The individual may be able to read rapidly, but hear the words as he reads, or he may be able to read almost entirely on the basis of a set of symbols which by now need no primary stimulus reference.

It is proposed to test the above model by a series of studies:

1. One study is normative in character, requiring a longitudinal follow-up of children learning to read. In this study, electromyograms of the vocal muscles and other measures would be obtained on children over a period of several years.
2. A study of the relationship of difficulty to subvocalization. This study will experimentally vary material of different difficulties and measure tendencies toward sub-vocalization in relation to difficulty levels. By experimentally varying the difficulty level of the material read, using both vocal and more general measures of muscular activity

as dependent variables, a *post hoc* test of the model will be possible.

3. The third study is a replication, with improved controls, of some work already done in thes area. In this study, college students who subvocalized were treated by amplifying of the vocal muscles during reading and having the subject listen to it over earphones. The subject was instructed to read while keeping the noise in the earphones to a minimum. Preliminary results indicate that this continuous feedback technique is quite successful in reducing the amount of subvocalization.
4. If the mediation model is correct, elimination of subvocalization by the feedback technique used above should result in either facilitation or inhibition of reading speed, depending on the stage of development of the subject at the time the feedback technique is administered.
5. A fifth study will take advantage of a rather unique patient population. Patients who are to undergo surgery for cancer of the larynx will be studies by electromyographic techniques prior to surgery. Following surgery, electromyographic studies of muscle activity during reading while the patient is learning esophageal speech can be done.

STIMULUS FACTORS IN LITERACY: "SHAPING" VERBAL AND NONVERBAL GRAPHIC COMMUNICATION

Julian Hochberg
Cornell University

Learning to read is probably not a central problem in literacy in its broader sense: since children occasionally teach themselves to read with little or no assistance, devising instructional procedures cannot be insuperably difficult; furthermore, innumerable people who can read are functionally illterate, because they won't consume the printed word unless embedded in certain kinds of pictorial content.

The main problem seems to me to be one of motivation, of interest, therefore, not of learning.

I am concerned with the uncovering and evaluating the various stimulus determinants of graphic reinforcement and interest — the characteristics of such picture-text amalgams as picture books, illustrated magazines, and even comic strips, which, when successful, instigate and maintain reading behaviors. Some graphic displays are essentially "teaching machines"; most are not. When we understand the successful ones, we shall be able at will to induce self-instructional reading behaviors in young children, both for its own sake, and so that we can study how this apparently painless process can be applied to others, and we shall be able to extend literacy to the functionally illiterate.

As a start: pictures provide graphic interest to picture-text amalgams in two ways: (A) Pictures are intrinsically more attractive or attensive than text. (B) Pictures are more informative in many ways (and without special educational procedures required to absorb the information) than text. In both cases, questions of balance, of optimal redundancy, of desirable kinds of specialization between the two media (or components), suggest themselves after even the most cursory study of the problem. We are making fair progress in measuring contributory stimulus factors, substantive or meaningful as well as "mechanical" or compositional (measuring the substantive stimulus factors by the value of a given picture of sequence for reducing the equiprobability of alternative interpretations or "endings" of ambiguous text segments), but important sources of variance still elude us.

Dependent variables are: For class A factors: units of display (pages, "frames" in comic strips, etc.) perused ad lib, recorded by covert observers; covert gaze records via concealed cameras; reading comprehension tests. For class B factors: reluctance to interrup perusal of experimental book or strip; resistance to satiation (or tolerance of repetitions) before relapsing to idleness in a "cover task" of waiting for an experimental interview; most ambitious, but as yet unattempted: a covert eye-recording device which will measure when the reader "defocusses" his eyes and "woolgathers".1/

1/ The last measure depends on the feasibility of a new instrument, now being constructed in pilot form, which is worn like spectacles and which yields digital output concerning the position of each eye in its socket, thus permitting measuring both the fixation point of the reader and the degree of convergence (which is an index of accommodation or focus); because of its digital output, records should be readily analyzable, and the immediate control of stimulation, via feedback programs, becomes possible: thus when the reader stops concentrating on a page, or fixates for too long a period, a bell can ring, or more dramatically, the display at which the eye is directed may itself be changed, stabilized, etc.

READING AS A PERCEPTUAL SKILL

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Reading is pre-eminently a psychological process. There are many thousands of alphabets, and each is as good as any other as the medium of information exchange: the stimulus materials (the characters) are entirely arbitrary, the skilled reader is often indifferent to variations in the form of the stimulus (font, size, and the like), and most often, barely "sees" the stimulus at all. Skilled reading extracts "information" from the visual array, not visual targets, but we know very little of how this information-extracting takes place.

Two sets of experiments were designed to study this process of extracting information; in method, they required subjects to read materials that had been transformed either temporally or spatially.

In one set of experiments, college students tried to recognize words presented one letter at a time in identical positions on a projection screen. Some of the words were categorially ambiguous; consisting of six letters, they can be read as two three-letter words or as one six-letter word. Examples are CARROT, COTTON. The duration for which the letters were presented, and the length of the blank pause between the offset of the third and the onset of the fourth letters were varied. Other kinds of words—indivisible six-letter units (ORANGE) or two three-letter (CUP BOY) also were presented. The principal findings were that a single six-letter word is easier to detect than two three-letter words, and that categorially ambiguous six-letter words are easier to detect than indivisible ones, at all letter durations. The import of the latter finding is unclear for the moment. Also, at letter durations below about 100 milliseconds, a curious and interesting anagramic effect occurs: the subjects can detect all the letters, but report them in incorrect sequence. This was especially noticable with nonsense syllable stimuli, although it occurred as well with words.

In a second set of experiments, subjects were required to read normal English text that had been subjected to geometric transformations: rotation, inversion, reflection, and letter reversal. The transformations, while logically equivalent, are not perceptually equivalent: a clear rank-ordering is apparent in their readability. Of greater interest than mere difficulty, is the way subjects learn to read the transformations. When first presented with a page of transformed text, the subjects deliberately and carefully figure out the nature of the transformation; their reading at this stage can be characterized as a problem-solving process. Practiced with one page of each of eight transformations on each of eight days, the subjects rapidly discard this problem-solving approach, and merely "read", much as they would normal text, albeit somewhat slower. Their spontaneous comments indicate that their comprehension of the material is minimal at the earlier stages, but improves with their skill. In a subsidiary experiment, two groups of subjects read five pages of one kind of transformed text (mirror reflection) on each of five successive days. Twenty-one of the pages were read with one eye only, the remaining four with the other eye only. Transfer between eyes was virtually perfect. However, of the subjects, a few were

Americans majoring in Middle-Eastern studies with a reportedly good reading knowledge of at least one Semitic language (typically Hebrew or Arabic), languages which are read from right to left. These subjects were far superior to the others in their ability to read English text from right to left. We assume their greater skill came from practice in processing written material from right to left, not from practice in reading English in mirror reflection.

Two qualitative observations finish this summary. One is that a subject often can recognize the letters of a word that has been transformed either temporally or spatially, but still be unable to identify the word itself. This identifies for us the fact that recognizing a word involves processes of a different kind from mere recognition of its constituent letters. The second observation emphasizes the "program" nature of reading: the subjects who read twenty-five pages of transformed text, described above, were also tested with one page or normal English text at the beginning of the first and at the end of the last day's testing. Presented with a page of normal English text to read after having read several pages of transformed text, the subjects characteristically were unable to read the normal text, taking as long as thirty seconds to identify the first word. But once recognized, the normal text was read off without impairment.

NEUROPSYCHOLOGY OF RECOGNITION AND INTERSENSORY ASPECTS OF READING

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Reading is clearly an intersensory process. The maturational development of the prerequisite skills for reading involve the acquisition of an auditory recognition vocabulary followed by a speaking vocabulary. These two processes become a receptive (hearing) and motor (speaking) association to which visual configuration (printed word) is attached as the child learns to read.

Recent research has pointed to the importance of central auditory-receptive deficits in dyslexic children. Children with a central auditory-receptive deficit cannot be distinguished by pure tone audiometric screening techniques. Their difficulties become evident only as the complexity of the auditory recognition task increases or as the stimulus becomes masked or distorted. Clear differences are evident in normal and retarded readers when they are required to discriminate distorted or masked words. Further, discrimination of meaning is lost if the syllables of words are separated distinctly across time.

The importance of parallel central visual-receptive processes in the acquisition of reading ability has not been investigated to the same extent as has the auditory modality. Nor have the aspects of intersensory association of simultaneous auditory and visual stimulation been contrasted for adequate and non-adequate readers.

The contribution of ocular and optical defects to reading disability remains an unresolved question. Whereas Helen Robinson reports that visual anomalies were found in 73 percent of cases studied fully, these were considered as contributory causes of reading disability in 50 percent of cases. On the other hand, Helen Shimota reports a significantly higher percentage of visual anomalies in adequate readers than in retarded readers . The relationship between peripheral vision defects and cortical visual-receptive deficits is essentially unknown.

The Bascom Palmer Eye Institute houses the Department of Ophthalmology of the University of Miami School of Medicine. The research and diagnostic facilities make feasible a detailed investigation of the mechanisms underlying visual discrimination and visual recognition. Complete Ophthalmological and orthoptic examinations are available for each child studied. Location of the Institute in the medical school complex will allow for diagnostic screening by the departments of pediatrics, neurology and otolaryngology (including speech evaluation).

The Eye Institute has recently acquired an evoked potential computor. This device computes across time a quantitative measurement of cortical (occipital lobe) activity which is synchronous with a visual (or auditory) stimulus over and above normal on-going cortical activity. The evoked potential technique has never been utilized in the study of dyslexia. We feel it holds great promise.

In general, the proposed research project will study intellectually matched populations of normal and dyslexic children with regard to:

1. Visual discrimination (simple and complex)

2. Visual recognition (threshold levels)
    a) effect of masking
    b) effect of blurring
    c) effect of temporal separation
        1) of syllables in words
        2) of sequential action
    d) tachtistiscopic recognition (simple, complex and overlaid figures)

3. Auditory discrimination

4. Auditory recognition
    a) effect of masking
    b) effect of blurring
    c) effect of temporal separation
        1) of syllables in words

5. The interaction effect of simultaneous intersensory stimulation of visual and auditory modalities will be studied for each of the experimental situations listed above. By presenting a blurred, masked or distorted visual stimulus simultaneously with a blurred, masked or distorted sound, the threshold of recognition should be enhanced. The degree of enhancement is predicted to be less for the dyslexic child. A comparison will be possible within groups between single and dual stimulation recognition thresholds.

6. Cortical responsivity to visual and auditory stimulation (evoked potential technique) will be quantitatively measured.

All children will receive an EEG, speech evaluation, ophthalmological and audiological evaluation. Level of reading proficiency will be ascertained by a consultant to the project with extensive experience in the diagnosis of reading problems.

EIDETIC IMAGERY IN CHILDREN—SUMMARY OF RESEARCH[1]

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Some children (and a very few adults) are able to maintain a complete visual image of a stimulus from which they can describe the stimulus in detail. This eidetic imagery is notably different from most adult perception, in which any visual image of a stimulus fades almost immediately (lasting generally no more than a few hundred milliseconds) and a description of the stimulus must be based on a normally incomplete memory. Eidetic imagery has been differentiated from memory by its preservation of fine detail, by S's reports that a visual image still persists after the stimulus has been removed, and by behavior which indicates that S is indeed attending to such an image. It is distinguished from after-images by its long duration, by the ease of evocation from even low-contrast stimuli, by its positive representation of color, by its independence of visual fixation during inspection, and by the lack of effects of eye-movements during report of the image.

In the first stage of our research, all children in two elementary schools in New Haven were tested for the presence of eidetic imagery using a standardized procedure, to assess both the number of children possessing this kind of imagery, and something of the nature of the imagery itself.

Briefly, the testing consisted of showing each child a picture (one of four) for 30 seconds, removing it after he had thoroughly scanned and examined it, and then asking whether he could still see any image of the picture on the background where it had been. Prior to the presentation of the four pictures, the children were shown stimuli designed to elicit after-images, both to have a measure of after-images, but more importantly to demonstrate to the child what is expected of him. Careful observation of eye-movements were made during inspection and report of any imagery for each of the four pictures. A complete recall from memory of each picture was also obtained after whatever imagery there was had faded.

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[1] This research has been supported by a grant from NIMH (MH-03244) during the past 5 years. My wife, Ruth B. Haber, has been a collaborator throughout the project.

While 55% of the children reported having an image to at least one of the pictures, only 8% (N=12 in the second school where most of the detailed analyses were completed) reported images to all of the stimuli which met the criteria for eidetic imagery. The shortest of their images were 40 seconds, while the average was over three minutes, and nearly all were positively colored. Each of these images were scannable during report, while none of the other Ss reported an image that could be scanned. Accuracy of detail was rated on a nine-point scale from a tape recording of S's report: the eidetic images were nearly perfect, in that S could not only report all of the objects in the pictures, but their orientations and finer attributes. For example, in one picture, all of the feathers worn by each of ten Indians could be counted correctly, the colors in each of the blankets identified, and the arm positions and expressions of each person indicated. It would be very difficult to differentiate whether the child was giving his report from an image of the stimulus or from the stimulus itself. In contrast, the images reported by the other Ss were greatly impoverished, were often of a shadow or film color, or of single objects without detail.

The twelve eidetic children ranged from eight to twelve years of age. Half of the eidetic children were boys, and half were Negro (the same proportions as in the schools). As a partial longetudinal study, nine of these children were retested one year and again two years later. Eight of the nine were still eidetic, and to the same extent on both further testings.

We are just completing intensive formal psychological testing, including intelligence tests and projective evaluations. We are planning detailed interviews with the parents, teachers and the children themselves. These will include not only questions regarding the eidetic imagery directly (all twelve were quite aware of this ability—and think all children can see this way), but also whether the parents have noticed it, and if so, when, and how it has affected other cognitive skills especially learning to read and form concepts.

The second line of research is more perceptual, and concerns the use of these eidetic children as Ss in experimental tests of the duration of imagery, using procedures we have developed to measure the duration of short-term memory, and in tests of recovery of unavailable memory through the use of association tasks as a recovery aid.

RESEARCH PLANS AND PRELIMINARY RESULTS RELEVANT TO PROJECT LITERACY

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and
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Our present and proposed research relevant to Project Literacy derives from "graphic discrimination" studies and "reading-pronounciability" studies carried out as part of the Cornell reading project.

Studies of the discrimination of graphic forms. Previous investigations have shown that children between the ages of four years and eight years improve in their ability to make visual discriminations among letter-like forms. Further studies of improvement in such discriminations, both visually and tactually demonstrated the importance of "distinctive features" in learning such a task. It also appeared that conditions of comparison-successive or simultaneous-predicted the extent to which a type of "schema" learning accompanied distinctive feature learning. One of our current projects is an investigation of this phenomenon cross-modally.

In one experiment Ss (first graders) were trained to discriminate visually between "standard" letter-like forms and variations of these. These variations or comparison forms were transformations of the standard forms such as rotations and reversals, line and curve changes, perspective size changes. After training these Ss were given a transfer task in which they were asked to discriminate tactually between letter-like forms varying systematically from those they had in training. A second group of Ss learned to discriminate tactually between some letter-like forms and then were given a transfer task to which they were asked to discriminate visually between some forms varying systematically from those they had previously learned.

A preliminary analysis of these results suggests that it may be the transfer conditions and the extent to which these involve simultaneous or successive comparisons, rather than the training conditions, which affects the extent to which schema-type processes accompany the learning of important dimensions of difference in such a task.

One related project which we will begin shortly is a developmental study of the tactual discrimination of letter-like forms and the comparison of these results with the previous developmental study of visual discrimination of these forms. We hope that these data will suggest a model which will integrate all the present results.

Studies of the role of grapheme-phoneme correspondences in word perception. Previous investigations have shown that the extent to which there are high grapheme-phoneme correspondences in letter combinations affects their perceptibility. For both children and adults letter combinations have high grapheme-phoneme correspondences, i.e., letter combinations which are pronounceable, are more quickly and more accurately perceived than letter combinations which are unpronounceable. Currently, we are investigating the effect of pronounceability on perception for children who read Braille.

Pronounceable and unpronounceable letter combinations, written in Braille were presented individually to blind, Braille-reading students from ages nine to 21. The pronounceable and unpronounceable letter combinations consisted of different arrangements of the same letters. Ss were asked to read to themselves and spell aloud each word in succession as quickly as possible.

For all but one of 26 Ss, the pronounceable words were read more quickly than the unpronounceable words. Errors also showed a significant difference in favor of the pronounceable words despite the fact that Ss took more time to read the unpronounceable words and hence might have been expected to read them as accurately as the pronounceable words. The types of errors made by these Ss are interesting and we are attempting a systematic analysis of them.

Another investigation which will shortly be undertaken is relevant to both of the kinds of problems which we are studying. This project will be to obtain from both sighted Ss (working blindfolded) and blind Ss a confusion matrix for Braille forms. Ss will be asked to compare Braille forms with each other and to make same and difference judgments. The patterns of perceptual confusions which are made by both types of Ss will, we hope, suggest generalizations about tactual discrimination processes and further elucidate the kinds of errors made by Ss in the pronounceability study just described.

The study of the grapheme-phoneme correspondences in perception is leading us in one further direction. In order to shed some light on the mechanism of this apparently quite general facilitating effect of pronounceability on perception, we have recently begun a study which manipulates pronounceability as a subject variable. The study is being carried out in collaboration with Dr. Mildred Templin of the University of Minnesota, Institute of Child Development.[1] Dr. Templin has been conducting for the past several years a longitudinal study of speech pathology. These Ss are being compared in their ability to preceive visual and auditory verbal stimuli to other groups who have had speech difficulties but have overcome them as well as to groups who have never had any speech difficulties. Preliminary analysis of overall errors suggests that the present speech-difficulty groups are inferior in the perception of visual verbal stimuli to the normal groups and the improved groups.

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[1] Mr. Robert Klein has participated in the planning of this study and had directed the data collection.

COMPREHENSION WITH USE OF PHONIC TEACHING METHODS

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During the last few years I have been studying the development of formal reasoning in children aged six to twelve years. The children have worked on highly schematized concept formation tasks similar to those used in studies with adults, e.g. by Hovland and Weiss; Bruner, Goodnow and Austin. These problems all required the children to discover which one of a small set of binary attributes activated a light. Depending on the sequencing of positive and/or negative outcomes of instances on these problems, the number of inferential steps required to obtain answers varied. While small children were relatively successful in isolating these simple one-to-one relationships with sequences requiring few inferential steps, they were totally unsuccessful with those requiring several such steps. The sources of difficulty did not appear to result from inability to carry out any of the single inferences required but rather arose from the necessity to execute a sequence of such inferences.

These findings have aroused my interest in children's general capacity to hold onto and integrate sequences of elements in larger meaningful units. Obviously, such skills are required for learning to read. The child must hold sequences of phonemes until an entire word has been sounded and/or sequences of words until phrases and sentences are complete. I wonder whether children gain much of the meaning of passages while attempting to integrate units into new sequences or whether such passages must be repeated several times or require the aid of a teacher or picture.

Several allied questions arise. Assuming, for example, that phonic teaching methods are used:

1. How long a sequence of phonemes can the child sound out into a new sequence and be able to figure out the word he is sounding? Does the size of the population of letters to which they have been introduced affect this skill?
2. What effect does overlearning of units have in increasing the ability to integrate these units into sequences? Correlative with this question: Is the rapidity and ease with which letters may be sounded important for determining the meaning of words?
3. How well can children handle disjunctive possibilities for the sound of single letters? e.g. Does a letter known to have two alternative pronunciations, introduced early in a sequence, disrupt "holding" the entire sequence?

SUGGESTIONS FOR RESEARCH ON THE USE OF THE CHILD'S KNOWLEDGE OF SPOKEN LANGUAGE IN THE TEACHING OF READING AND WRITING

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To make maximum use of the child's well developed speaking knowledge of language in the teaching of reading and writing it seems important to give the child at the outset an awareness of the relationships of spoken and written language — for example, that both are forms of communication and that writing serves as a way of recording spoken language. This could be accomplished by presenting reading and writing as a "conversation game" — perhaps in a larger context where dialogue between tutor and learner may be carried out by speaking, acting out with gestures, drawing pictures, reading and writing, etc. This approach might well introduce the child to some of the potentials of written communication — that it provides a fairly permanent record, enables communication in absence of the communicator, and so forth — and should point up why some of the "rules" of reading and writing are necessary — such as punctuation marks to indicate pauses and intonation. In addition, such a written dialoque would provide a mechanism for immediate corrective feedback to the learner for mutual comprehension among the participants can be checked by judgments of whether statements given in response follow from correct understanding of prior statements or by the action consequences when statements include instructions to be carried out by tutor or learner. In the initial stages of reading and writing, where the learner's ability to produce statements with paper and pencil are not well enough developed for ease in playing such a "game", word cards might be devised from which the child (and the tutor) could select and build sequences.

In addition to engaging the child in a search for relations between spoken and written language, using the child's speaking knowledge of language in teaching reading and writing requires an examination of what indeed one has to build on in the attempt to establish correspondences between the printed page and the child's spoken language. Thus it seems of importance to determine how the child segments the flow of spoken language. By providing the child with a notation system for representing the units he forms he may be led to the more conventional units of written notation. If, for example, the child has some sense of an utterance or sentence as a segment of spoken language, he might be provided with a notation for the representation of this unit. From a set of such utterances in notational form, the child may be led to discover further subdivisions by noting what regularities occur within his segments. Thus, comparison of differences and regularities occur within sets of utterances as spoken and as written may give the child much of the information he needs to draw correspondences between the units of speaking and of writing.

Concurrent with the division of utterances into units, the child should begin the construction of new utterances by combining segments of previously produced sentences. This sort of activity may illustrate the useful units to employ in written notation and may bring the child to an understanding of the difference between lists of words and sentences.

It seems likely that this approach to the teaching of reading — since it stresses both the communication process and beginning where the child is in terms of the segmentation of speech — would involve emphasis on the utterance as a basic unit. Taking the utterance as a basic unit of organization for the teaching of reading and writing may enable the child to bring to the reading situation the ability he has in spoken language to integrate smaller units (phonemes, words, etc.) in a "planful" fashion and thus avoid losing the thought for the separate words or the words for the separate letters.

ELEVEN HYPOTHESES IN SEARCH OF A METHOD

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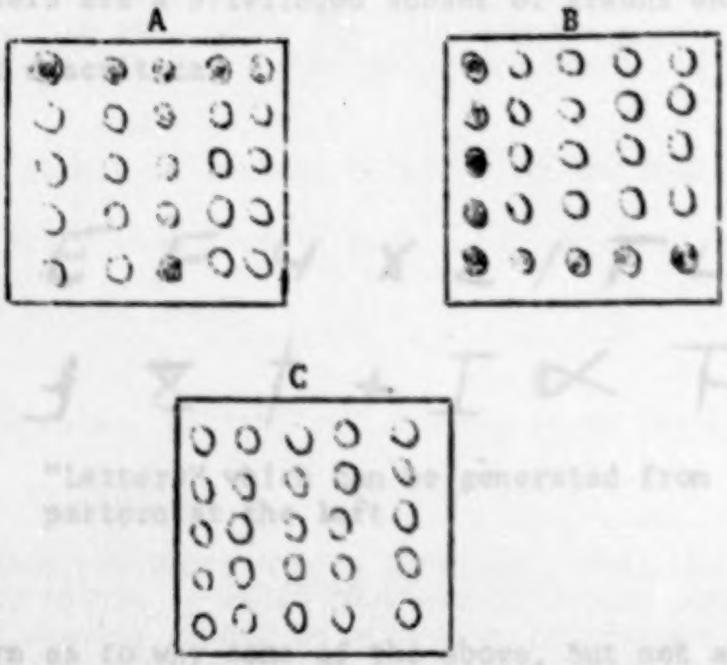
Hypothesis 1. There is a sharp difference between image space and information space. Reading involves learning to distinguish between information spaces, not image spaces.

Experiment:

Bulb boards:



Task: Child was shown the two boards A and B, each of which had a letter picked out by lighted bulbs. Board C was unlighted but any single bulb could be illuminated by touching it. On each trial the bulb was wired so that the single lights forming either the letter shown on board A, or the letter shown on board B could be illuminated by touching the bulbs. The child's task was to discover which one of the two alternatives could be lighted (i.e. which of the two letters was 'on' the board).

Results: 4 year olds - pushed random buttons. When asked why he had pushed a button and then changed to another (when no light appeared) he would answer, "Because it wasn't there."

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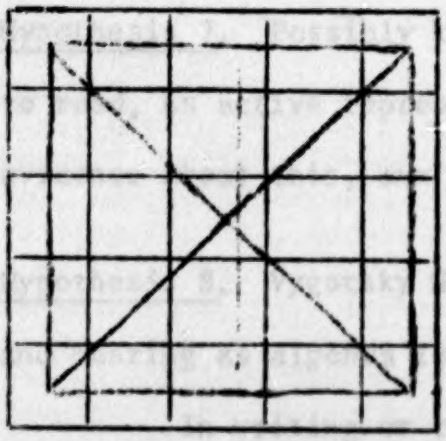
* Notes on a seminar talk delivered June 18, 1964, MIT Endicott House, Dedham, Massachusetts

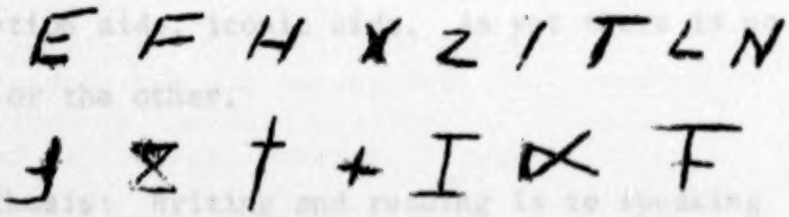
Questions directed at trying to find out what "it" referred to didn't elicit much of an answer.

Older kids - at first would push the non-discriminating buttons (i.e. where the two letters would overlap). Then they would push discriminating lights (i.e. ones which would light if it were one of the letters, but not if it were the other).

Group data shows that the proportion of discriminating to non-discriminating responses increases with age. Individual data shows that the change from non-discriminating to discriminating responses comes with a bang.

Hypothesis 2. English letters are a privileged subset of graphs which can be generated by a set of diacritica.





"Letters" which can be generated from the pattern at the left.

There is no pattern as to why some of the above, but not all of them are used in our notation. Once the rules for generation are known it may be easier to separate the selected ones from the non-selected.

Hypothesis 3. Perhaps practice in "babbling" in writing would make it easier for the kid to generate the alphabet.

Hypothesis 4. A subset of the alphabet may be discriminable in terms of certain oppositional contrasts.

Perhaps good teaching tactics might highlight contrasts relevant to alphabet choice. e.g. size does not matter, but right-facing vs. left-facing does—

C vs. Ɔ; E vs. Ǝ; R vs. Я; N vs. И.

Toys could be used to assist in discrimination.

Hypothesis 5. The Bloomfield Hypothesis: Letter discrimination must be learned in context. e.g.

Stop
Step
Stip
Stap

Spore
Store
Snore
Score

Hypothesis 6. Relevant rules for writing have not yet been learned for oral-oral discrimination. The child has not yet learned segmentation—he doesn't know what a word is.

> The child could be trained to practice segmentation in the spoken language. Until he has some basis for discriminating words in the oral flow, he has no basis for matching graphemes and phonemes.

Hypothesis 7. Possibly kids should be trained to write before they learn to read, as active representation aids, iconic aids. As yet there is no evidence about this, one way or the other.

Hypothesis 8. Vygotsky Hypothesis: Writing and reading is to speaking and hearing as algebra is to arithmetic.

> In writing or reading you don't have a referent. But, childrens' first words are for things in which they are in visual contact. Therefore, perhaps reading should be much more concretized—perhaps one should have the referent right there and have someone say it back to the child as he writes.

Hypothesis 9. In writing and reading as in speaking, there is a major problem with the functors. More concrete embodiment could be given to these.

Hypothesis 10. There is a need for a means by which the child can learn to use the redundancy of written English.

> Could give practice in this by taking out 30% of the letters in a passage and getting the kid to put them back in the right place. Redundancy is an essential property which allows for the scanning mechanism. "If God delivered to the king of Prussia as imperfect a mechanism as the human eye, the king would say to God, "Take it back and work on it for another year."."

Hypothesis 11. Self-consciousness about language helps learning. Therefore we should perhaps teach linguistics in the first grade.

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REPORT OF THE

SECOND RESEARCH PLANNING CONFERENCE

"LINGUISTIC AND PSYCHOLINGUISTIC BASES OF READING"

Held Under the Auspices of

Project Literacy

in

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COMMENTS FOR PROJECT LITERACY MEETING

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Morris Halle and I have been working for several years on a study of English sound structure, some aspects of which seem to me to touch on the concerns of this meeting--in particular, on questions of dialectal variation, the psychological reality of linguistic units, and the nature of conventional orthography and its relation to the sound system.

When we consider the structure of a language we are, fundamentally, concerned with a relation of sound and meaning. The rules of the language--the rules that the native speaker intuitively commands and that the linguist tries to discover and exhibit--relate certain physical signals to certain semantic interpretations; more precisely, they relate phonetic representations of sentences to their structural descriptions. Thus one level of representation that must have psychological significance, both on the perceptual and motor levels, is the level of phonetic representation; another is the level of representation that appears in structural descriptions.

The level of phonetic representation is fairly well understood. Structural descriptions are a more obscure matter. Clearly, a structural description (adequate to express the semantic content of a sentence) must contain, at least, a representation of the meaning-bearing units of which the sentence is composed and of the phrasing of the sentence (and, of course, much more which we here disregard). Thus the structural description of the Phrase

"American history teacher" must contain the units *America*, *-an*, *histor-*, *-y*, *teach*, *-er*, and a bracketing indicating which of the two semantic interpretations is intended. Similarly, the word *theatricality*, for example, must be represented as a Noun derived from the Adjective *theatrical*, which is in turn derived from the Noun *theater*. Thus the grammar of a language must contain (at least) syntactic rules that determine phrasing and the placement of "grammatical" units such as *-er*, *-ity*, a lexicon that contains the semantically functioning units, and rules that convert structural descriptions to phonetic representations.

Consider now the character of the lexicon. It is easy to justify the requirement that each lexical item be represented as a sequence of *segments*. Each item, of course, has a unique such spelling--a single entry--in the lexicon. This spelling must contain all information not predictable by phonological rules (presupposing the rest of the structural description of the sentence in which the item is embedded). Thus the lexical representation of the common item of *histor-y*, *histor-ical*, *histor-ian*, or of *anxi-ous*, *anxi-ety*, or of *courage*, *courage-ous*, or of *tele+graph*, *tele+graph-ic*, *tele+graph-y*, etc., must be selected so as to contain just what is not predictable in the variant phonetic realizations of these items. The psychological reality of lexical representation, in this sense, is hardly open to question.

Observe that a lexical representation, in this sense, provides a natural orthography for a person who knows a language. It provides just the information about words that is not predictable by phonological rule or by the syntactic rules that determine the phrasing of the sentence in which the item is embedded. It provides just the information needed by a person who has command of the syntactic and phonological rules (up to ambiguity). Conventional orthography, in English, as in every case of which I have any knowledge, is remarkably close to optimal, in this sense. For example, the spellings histor-, anxi-, courage, telegraph are (minor notational conventions aside) essentially what would appear in the lexicon of spoken English. Conventional orthographies tend to differ systematically from lexical representation only in that true irregularities (e.g., man - men, cling - clung) are differently represented, as is quite natural. The symbols of conventional orthography correspond to feature sets, in the underlying sound system of the spoken language.

It seems fairly well established that the level of lexical representation is highly resistant to change, and is highly persistent over time (and hence over a range of dialects). Correspondingly, one finds that conventional orthographies remain useful, with minor change, over long periods and for a wide range of dialects.

As a result of our work, we have come to the conclusion that there is no linguistically significant (and, presumably, no psychologically real) level of systematic representation intermediate between the level of representation to which conventional orthographies closely correspond and (broad) phonetic representation. These underlying representations we call "phonological," following Sapir, our conclusions being closely akin in many respects to his views on the nature of sound pattern and phonological rules.

Following this usage, we may say that the relation between conventional spelling and phonological representation is very close, and that conventional spelling is, by and large, a highly effective system for a wide range of dialects because it corresponds to a common underlying phonological representation, relatively invariant among dialects despite wide phonetic divergence. Let me emphasize again the advantages of phonological (i.e., essentially conventional orthographic) representation _for a speaker who understands the language_. In contrast, broad phonetic (or, possibly, so-called "phonemic") representation is the only kind that would be of any use for someone who knows nothing of the syntax of the language but who wishes to produce a noise which is close to the phonetic form of a sentence--for example, an actor who has to produce a sentence of a language that he does not know.

Consider, in contrast, phonemic representation in the modern (post-Sapir) sense. The phonemic system, in effect, extracts all regularities from the sound system that can be detected with no consideration (or, in some varieties, highly restricted consideration) of higher level structure. A priori, there is no reason to suppose that such a system exists. For example, it is obvious that a child does not first construct such a phonemic system and then proceed to the problem of acquiring syntax and semantics, and there is not the slightest reason to believe that there is a level of perceptual processing (or of motor performance) that corresponds to phonemic representation, in the modern sense. Furthermore, we have offered several arguments in support of the conclusion that there is no linguistic justification for a phonemic level--that is, it can be incorporated in a full grammar only at the cost of otherwise valid generalizations. Consequently, it seems to me that phonemics, in the modern sense, is perhaps nothing more than a methodological artifact.

In considering problems of literacy, the questions of "phoneme-grapheme correspondences" and of dialect variation naturally arise. As to the latter, this is a problem only to the extent that dialects differ on the syntactic and lexical level. Differences in phonological rules are irrelevant, since orthography corresponds to a deeper level of representation than (broad) phonetic. Hence the question raised above (of uniformity of lexicon over time and dialect), and the analogous question with respect to sameness of deeper structures in syntax, becomes highly relevant. As to the question of "phoneme-grapheme" correspondence, it may be that this is something of a pseudo-issue, or more properly, a set of pseudo-issues, depending on how exactly it is interpreted. If by "phoneme" is meant the unit constructed in accordance with modern principles, there is no reason to expect any significant set of phoneme-grapheme correspondences, since it seems that phonemes are artificial units, having no linguistic status, whereas the "graphemes" of the conventional orthography do correspond fairly closely to a linguistically significant level of representation. Hence it is not clear why one should investigate phoneme-grapheme corespondences at all. (In passing, it should be noted that so far as relevant information is now available, the same seems to be true for other languages.) If the word "phoneme" is taken in the sense of Sapir, and "phonological representation" is the level at which all predictable differences are extracted, then the phoneme-grapheme correspondences seem quite simple--they are very close to one-one, given certain notational conventions and disregarding a class of true exceptions. On the other hand, if we use the phrase "phoneme-grapheme" correspondences to refer to the study of sound-letter correspondences, we are, in effect, simply doing phonology. Or, to be more precise, the only reasonable way to study sound-letter correspondences seems to be to utilize the fact that orthography corresponds closely to a significant level of linguistic representation--namely, phonological representation, in the sense used above--which is, furthermore related to sound by general rules--namely, the rules of the phonological component. Hence the study of sound-letter correspondences can be divided into three parts: phonology, the systematic (near one-one) relations between phonological segments and letters (or conventional letter sequences), and a residue of exceptions (some of which exhibit subregularities of various sorts). But the bulk of the study is simply investigation of the phonological pattern.

If this much is correct, then it would seem to follow that the rules of sound-letter correspondence need hardly be taught, particularly the most general and deepest of these rules. For these rules are in any event part of the unconscious linguistic equipment of the non-literate speaker. What he must learn (except for true irregularities) is simply the elementary correspondence between the underlying phonological segments of his internalized lexicon and the orthographic symbols.

However, there is one qualification that must be added to this remark. The conventional orthography corresponds closely to a level of representation that seems to be optimal for the sound system of a fairly rich version of standard spoken English. Much of the evidence that determines, for the phonologist, the exact form of this underlying system is based on consideration of learned words and complex derivational patterns. It is by no means obvious that a child of six has mastered this phonological system in full--he may not yet have been presented with all of the evidence that determines the general structure of the English sound pattern. It would not be at all surprising to discover that the child's intuitive organization of the sound system continues to develop and deepen until considerably later. Furthermore, it seems that children are much more attuned to phonetic nuance than adults--they "hear phonetically" rather than phonologically, to a considerable extent. Though I have no serious evidence, I have observed quite a few cases where children developing their own alphabet or learning to read insisted on a much narrower representation than would strike the adult ear as plausible. To take one extreme case, my oldest daughter at age five objected to using the same symbol for the two Stops in cocoa, as it turned out on investigation, because the difference in aspiration seemed to her sufficiently significant to require a different symbolization. Though this is hardly better than a guess, it is not particularly a surprising one. Thus it is a familiar observation that children can mimic and can acquire a new pronunciation much more readily than adults, and this may correlate with a more superficial (narrower) level of organization of the phonetic material. For various reasons, then, it may turn out that the psychologically real representation for the child changes and deepens with age, approaching the adult phonology with increasing maturity and linguistic experience. Serious investigation of these questions is far from easy, but it should shed much light on problems of speech perception and production and, perhaps indirectly on the problems of literacy as well.

SPELLING TO SOUND: RULES AND A MODEL

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Richard Venezky
Stanford University

The objectives of this project are two-fold: the first is to formulate all possible spelling-to-sound correspondence rules by analyzing a tabulation of the spelling-to-sound relationships in about 20,000 English words. These rules will be based upon features of phonology, as well as morphology and syntax. The purpose of these rules is to predict with the highest possible accuracy the pronunciation of English words from their spellings.

The second objective is to present a model for spelling to sound relationships which reflects the habits of a mature adult reader.

Procedures

The basic data to be analyzed were obtained by a computer program written by R. Venezky in coordination with the Reading Research Project at Cornell University (supported by U. S. Office of Education Grant No. 639). From these data, which include spelling-to-sound tabulations, a search will be made for conditioning factors within words which indicate which of several possible pronunciations for a particular grapheme occurs. Computer studies will be used to assemble data on environmental features within words and also to test the relative accuracy of sets of rules based upon different size spelling units. The formulation of spelling-to-sound rules will be based upon techniques of description adopted by the authors from those currently used in descriptive linguistics.

To account for the phonemic and morphemic characteristics of the existing orthography, two types of correspondences have been formulated: grapheme to morphophoneme, and morphophoneme-to-phoneme. The complete description of English spelling-to-sound correspondences is composed of sets of rules for each of the two types of correspondences, and of an inventory of graphic representations of allomorphs of English morphemes. By using ordered rules on two different levels (grapheme→morphophoneme and morphophoneme→phoneme), the graphemic and morphemic aspects of the orthography on the one hand and morphophonemic alternations and phonotactics on the other can be clearly described. Thus, for example, the various pronunciations of the cluster <ch>, which depend upon whole words in which they appear are described on the grapheme→morphophoneme level. The various pronunciations of the noun plural <-s>, on the other hand, which depend upon regular morphophonemic rules, are described on the morphophoneme→phoneme level.

Within each level, rules are ordered to produce the most economic statement of correspondences. The first grapheme→morphophoneme rules account for the exceptions to the more general rules so that the correspondences in the largest number of forms can be referred to as ELSE. In the morphophoneme→phoneme rules, phonotactic rules are applied last since they operate upon phonemic units.

In reducing this description to rules for teaching reading, the graphemic allomorph inventory will contain items that must be presented in toto for predicting their pronunciations. The morphophoneme-to-phoneme rules represent habits that native speakers of English have by the time they attempt to read, while the other sets of correspondences represent rules that must be taught in one way or another.

Along with the rules which will be formulated, extensive word lists for each rule will be presented.

PROPOSAL FOR A RESEARCH PROGRAM IN WRITTEN ENGLISH AND ITS RELATION TO SPOKEN ENGLISH

Charles F. Hockett*
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The classical view of the relation of writing to speech (as expounded, for example, by Leonard Bloomfield in his book Language or, with minor modifications, by me in my Course in Modern Linguistics) held, in essence, that writing is but a record of speech. Different types of writing systems represent speech in different ways, on the basis of the type of linguistic unit assigned as the representate of the unit graphic symbol (e.g., alphabetic systems assign a written mark to each phoneme, character systems such as Chinese assign a written mark to each morpheme). Most writing systems have some intermixture between these two types, and, of course, many arbitrary irregularities. The classic view naturally leads to a certain basic policy in literacy training: essentially this policy is that if the learner is taught the correlations between graphic mark and linguistic unit, he has learned to read. (Those familiar with the literature on this topic will recognize this brief statement as a great oversimplification, but I believe it is essentially correct.)

Recent developments in theoretical linguistics, stemming from the first work of Noam Chomsky in the early nineteen-fifties, suggest that the classic view is not merely an oversimplification of the facts, which would be not very serious, but a distortion. Points that, under the classic view, have to be handled as "irregularities" may actually reflect a kind of regularity that is obscured by the classic approach but which should be discovered and exploited. Very briefly, the new view can be described as follows: a grammar of English bifurcates somewhere near the output end: by taking one fork, one generates written sentences: by taking the other, one generates spoken sentences. The written sentence need not be interpreted as representing a spoken sentence; rather, paired written and spoken sentences represent largely the same workings of the grammar.

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* Read by Richard Venezky at Second Research Conference

It is not at all clear how this approach might suggest pedagogical procedures other than those suggested by the classical view. It would be hard for that to be clear when, at the moment, we have virtually no notion of the details, but only a very general outline of what the grammar of a paired spoken and written language may be like.

It is proposed, therefore, that we undertake these two tasks: (1) a search, guided both by modern theory and by the obvious empirical data, for the more precise nature of the grammar of spoken-and-written English and the exact location of the bifurcation; and (2) a continuation, preferably with computer aid, of the sifting and classification of English written words on the basis of spelling-to-sound correlations, on the theory that this organization of the material is essential in the long run regardless of any changes of the theoretical frame of reference.

A PROPOSED STUDY OF NEGRO AND PUERTO RICAN SPEECH IN NEW YORK CITY

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1. The general aims of this study may be summarized under two headings:
   a. To determine the socially significant variables in English structure which separate Negro and Puerto Rican speakers from the rest of the New York City speech community.
   b. To define those structural and functional conflicts of the Negro and Puerto Rican vernaculars with standard English which may interfere with the acquisision of reading skills.
2. The research which is proposed in the following pages is an extension of an investigation of the socio-linguistic structure of New York City, as reported in my 1964 Columbia University dissertation, "The Social Stratification of English in New York City." In this study, it was found that the extensive variation found in New York City speech was not an example of random or "free" variation, as previous investigators had reported; on the contrary, the New York City speech community showed a very regular pattern of social and stylistic variation. Almost all New Yorkers showed the same direction of stylistic shift for the variables that were studied: the level at which this pattern operated was largely determined by the socio-economic position of the speaker. Furthermore, almost all New Yorkers reacted in the same way in judging the social

significance of these variables in the speech of others, as shown by their unconscious subjective reactions to these variables.

Despite this high degree of integration of the speech community through a common set of norms, there is also evidence of a significant deviation from these norms among some sections of the population. Whereas older Negro people in New York City participate in the same socio-linguistic structure as the rest of the population, many of the Negro youth seem to be moving in a different direction, along with many Puerto Ricans and lower class white youth. Among older Negroes, there is general agreement that Southern speech characteristics are "rough" and uncultivated compared to Northern speech. Yet there has been a rapid increase in the use of non-standard forms of Southern Negro speech in recent years: in part, this is due to the influx of Negroes raised in the South, but it also reflects a reversal of the value system held by the older generation, and a rebellion against middle class norms.

3. In the proposed investigation, each of the characteristic features of Negro and Puerto Rican English will be studied in several aspects: [a] its range of variation when used by the same speaker in differing contexts, [b] its distribution through the population, [c] its social significance as shown in subjective reaction tests and direct discussions of language. In the light of this information, the characteristic traits of Negro and Puerto Rican English may be classified into three types: indicators, which mark the group by objective distribution, but show no stylistic variation or subjective response; markers, which show

stylistic variation and patterns of unconscious subjective response; and stereotypes, which may or may not show clear-cut objective distribution coincident with the group, but which fluctuate in contextual styles and are topics of overt discussion.

All of this information will be utilized in determining the over-all structure of the Negro and Puerto Rican speech communities, as sub-groups of the larger New York City speech community. Within this structure, there will be various degrees of conflict with standard English, in relation to both the spoken and written forms. These conflicts may be of two types: [a] structural conflicts--differences between the rules and structural categories of the vernaculars and standard English, at varying levels of generality, and [b] functional conflicts--differences in the value systems symbolized by the structural differences, and depending in part upon the status of the individual features as indicators, markers or stereotypes.

4. Many of the methods utilized in the earlier study of New York City will also be used for the study now proposed. Interviews with 36 adult Negro informants from the survey of the Lower East Side have already been studied in some detail, and offer possibilities for controlled comparison of a great many variables specific to the Negro group. In addition, a modified form of this interview is being used this summer with 50 delinquent Negro boys who have been sentenced to terms at state institutions, and 25 Puerto Rican boys with the same status.

Beyond these methods, it will be necessary to devise a number of new techniques to accomplish the aims described above.

a. One of the most important tasks will be the training of a Negro interviewer, and comparison of interviews conducted by him with those conducted by white interviewers. This can be done most effectively by split interviews: breaking off sessions conducted by one person, and having them completed by another. It is possible that speech obtained by a Negro interviewer will be significantly different from the most casual and spontaneous speech recorded in past interviews: In any case, resolution of this question will in itself be an important finding.

b. It will also be important to compare the speech of individuals, when they are talking alone with an interviewer, to the speech of the same individuals in the midst of their immediate group of friends and associates. Techniques of working with small groups, forming both closed and open networks, may follow those developed by John Gumperz in his recent work in Norway [reported in the forthcoming issue of the American Anthropologist on "The Ethnography of Speaking."]

c. The subjective reaction tests used in the past have been confined to the value systems which reflect middle class norms. It will be necessary to elicit and measure opposing value judgments from the same speakers, reflecting values which reinforce the patterns of working class speech in New York. Scales which allow the listener to register his judgment of the masculinity of the speaker, his trustworthiness, or the listener's sense of identification with the speaker, must be developed.

d. The previous study was most systematic in the sampling of adult speech. It will be necessary to make more detailed investigations of children's speech, especially that of pre-adolescent peer groups, in order to study the development of verbal skills. From evidence already gathered, it appears that children first learn to read fairly early in the sequence of acquiring skill in the use of standard spoken English: The recognition of the social significance of vernacular forms, and the use of many superimposed styles of careful speech, are often not learned until the late teens. It will also be possible to investigate the suggestion of Noam Chomsky that children may not have the same morphophonemic system as their parents, since they are not familiar with the patterns of morphophonemic alternation that depend upon less common words of Romance origin.

e. For the systematic investigation of the English spoken by Puerto Rican youth, it will be necessary to conduct parallel studies in Puerto Rican Spanish--first, to determine the main patterns of bilingual interference, and second, to isolate the socially significant variables in Spanish as possible prototypes of similar variables in the English used by this group.

A PROPOSAL FOR THE STUDY OF THE GRAMMAR OF NEGRO ENGLISH IN NEW YORK CITY

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Aims

To analyze the grammatical structure of Negro English, to discover significant deviations from the standard vernacular.

To determine how far these structural differences are responsible for interference in the acquisition of reading skills.

Background

The proposed project will extend the work begun by the investigator in her recent analysis of the structure of Jamaican Creole. See her 1964 Columbia University dissertation. Jamaican Creole Syntax: A Transformational Approach. The report of a study of the socio-linguistic structure of the New York City speech community by William Labov indicates that the structure of the vernacular plays the most important role in the child's success in learning to read and that in turn the failure or success in learning to read may set the pattern which affects the acquisition of other language skills.

In Labov's New York City survey, he found that the number of non-standard grammatical forms used by Negro subjects was of a much greater order of magnitude than the number used by whites. Some of these non-standard features--such as double negatives, or simplification of consonant clusters--are also found in the speech of whites. Others are apparently limited to Negroes: for example, the double plurals mens, teeths, alphabets, peoples, or the absence of the copula in predication: you weak, man.

Such special forms, which are in practice confined to Negro speakers, raise the question as to whether the grammar of Negro speech reflects an underlying Creole grammar. The assumption behind such a possibility is that there was a Creole spoken throughout the South and possibly, also in the North, during the early days of slavery, with a syntax similar to that spoken in many parts of the Caribbean today, in the islands off the coast of Georgia and South Carolina (Gullah), and also to that spoken in Sierra Leone and the Cameroon off West African coast. In none of the Creole languages, for example, does a copula accompany the predicate adjective.

The significance of such a finding, that an underlying Creole grammar has affected the grammar of present-day Negro vernaculars, would be that the non-standard features of Negro speech are more deeply rooted, more systematic, than previously considered. If such features are only isolated remnants of hetergeneous rural English dialects, they would resist any attempts to organize them into an integrated grammar comparable to those of Caribbean Creoles. Such a finding would lend strong support to Stewart's suggestion that the techniques of foreign language teaching to be applied to the teaching of standard English.

> ...since the individual cases of mismatch may derive from more general deviations in the overall organization of the two verbal systems themselves, it seems clear that isolated 'mistakes' will not necessarily be amenable to patchwork correction.

The need for a systematic description of the grammar of the Negro vernacular is of course independent of the historical question raised here, since effective methods of teaching standard English require the most general and precise statement of the differences in structure between the two systems.

Method

The Negro vernaculars will be analyzed on the principles of the transformational model. This will give the general rules which govern the pattern of speech production, rather than an inventory of the forms used in any particular body of speech.

As a first step in such a description, tape recordings of interviews with sixty Negro speakers from the 1963 survey of New York City will be analyzed for specific areas of concentration. The linguistic interview used in this survey was designed to isolate a wide variety of contextual styles, from the most casual speech to the most formal reading style. The sections of speech in each interview which can be identified as casual or careful speech have already been marked, through the use of both contextual and channel cues independent of the variables being studied.

New informants will then be selected for further study: four for detailed work, twenty for recording short stories and conversation, and others for short recording sessions. The grammatical statements resulting from these studies will be compared with those of standard English, with forms of provincial English which are said to underlie non-standard speech, and with Creole syntax.

The grammatical rules which are characteristic of various New York City Negro vernaculars will then be treated as social variables, and their distribution in various stylistic contexts will be charted among the various subgroups of the New York City sample, according to:

geographical background	sex
education	age
occupation	reading ability
socio-economic class	general attitudes towards language

The degree of interference in the acquisition of reading skill from each of these variables can then be analyzed (1) empirically, by correlating reading ability with these variables, and (2) abstractly, by stating the general rules needed to convert the vernacular to standard English.

A further source of linguistic material will be provided by fifty interviews with delinquent Negro youth, now being conducted in a project of Mobilization for Youth.

A DESCRIPTION OF THE CHICAGO SPEECH SURVEY

COOPERATIVE RESEARCH PROJECT 2107
COMMUNICATION BARRIERS TO THE CULTURALLY DEPRIVED

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Illinois Institute of Technology

Raven I. McDavid, Jr.
University of Chicago

The Chicago Speech Survey, begun in October, 1963, to investigate social differences in the speech of Chicagoans, uses the interview techniques of the Linguistic Atlas. Fifty taped interviews have been made by John Willis, graduate student at the University of Chicago, Melvin Hoffman, graduate student at IIT, and Lee Pederson, assistant professor of English at the University of Minnesota. These interviews sample the speech of ten middle class whites, ten middle class Negroes, ten lower class whites, and twenty lower class Negroes. Ten of the Negro interviews are with recent in-migrants, and three of the lower class whites interviewed were poor Southern in-migrants.

The questionnaire used is a shortened form of the Atlas worksheets, reduced to approximately 250 items. Much of the shortening was made possible by the elimination of rural vocabulary items and those items which were otherwise judged likely to be unproductive. Most of the items were chosen for phonological reasons; they include cardinal and ordinal numerals, days of the week, months, parts of the house, cooking terms, parts of the body, illness, etc. Grammatical items include the forms *heard*, *haven't* (for *ain't*, *hain't*), *he does*, *I am going*, *am I going?*, *am I not?*, *we were*, *it wasn't me*, *brought*, *bitten*, the personal pronouns, *ate*, *eaten*, *drank*, *drunk*, *sit*, *sat*, *those*, *didn't* *use to*, *caught*, *took*, *taken*, *sweated*, *swam*, *dived*, *drowned*, *climbed*, *kneeled*, *woke*, *written*, *taught*, *gave*, *began*, *ran*, *came*, *saw*, *torn up*, *did*, *fought*, *might*, *isn't* *doesn't*. In order to stimulate conversation with Negro informants one new vocabulary item was added, *soul food*, meaning excellent Southern cooking.

Samples of connected speech, some of them several minutes long, accompany most of the interviews. These follow no set pattern in subject matter. Their purpose is to provide data for a comparative study of the paralanguage (such features as tempo, intensity, pitch range, nasality, rasp, drawl, clipping, etc.). Although the importance of paralanguage has been demonstrated for the analysis of psychiatric interviews, this is, we believe, the first attempt to include paralanguage in dialect studies. Difficulties in handling such data are enormous. Dr. William Austin, who is analyzing the data, believes they will prove to be of great significance.

It had been hoped that it would be possible to program the raw material from the interviews for the computer. At this time, it does not seem to be feasible. The tapes are now being studied and charted in the usual Atlas fashion, and the conclusions will be available in the project report to the Office of Education in the fall of 1964.

Some generalizations which can be made are that the middle class white has the expected Inland Northern educated pronunciations and grammar, lower class native whites show a greater Midland influence such as 'open o' in *on*, and more relic forms. Middle class Negro speech tends to approach the middle class white norms, with one interesting exception that *aunt* is always pronounced with the low central unround vowel. As one moves down the social scale he finds Negro speech to be more and more like that of lower class recent Negro in-migrants.

The next phase of this study, scheduled for early fall is the measurement of attitudes toward speech forms and samples of connected speech. Judges will be selected from middle and lower class whites and Negroes. They will rate the speakers on the social scale, or possibly by occupation and education, and will also indicate whether they find the speech to be pleasant or unpleasant.

From the data of this study and other supporting information which has been gathered, a manual for the use of teachers in the Chicago schools is to be prepared during the coming academic year, in the belief that an understanding of the child's linguistic differences will better prepare the teacher to cope with the language learning situation.

PREREQUISITES FOR LINGUISTIC STUDIES ON THE EFFECTS OF DIALECT DIFFERENCES ON LEARNING TO READ

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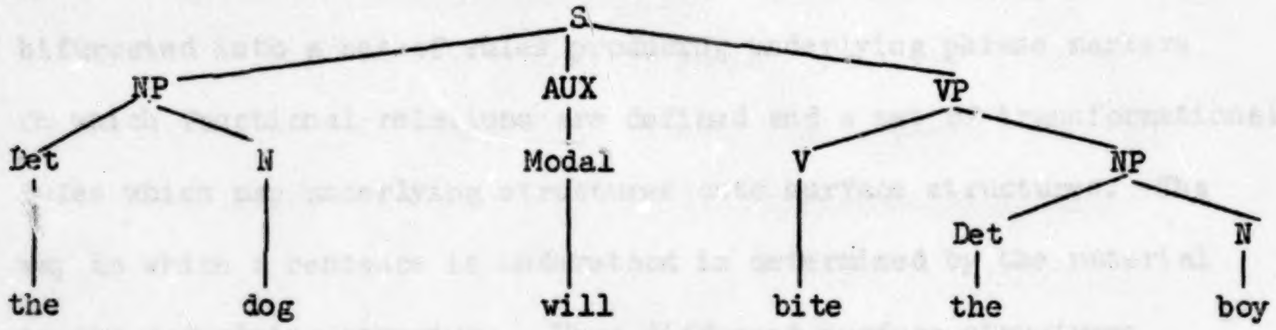
Linguists and educators have suggested that dialectal variation in phonology and syntax may contribute to reading difficulty. Requisite to the set of systematic procedures for verifying this hypothesis is a characterization of the notion dialect in terms of a precise linguistic theory which can provide the basis of an explanation of how sentences, written or spoken, are understood and how this linguistic ability is learned by the child.

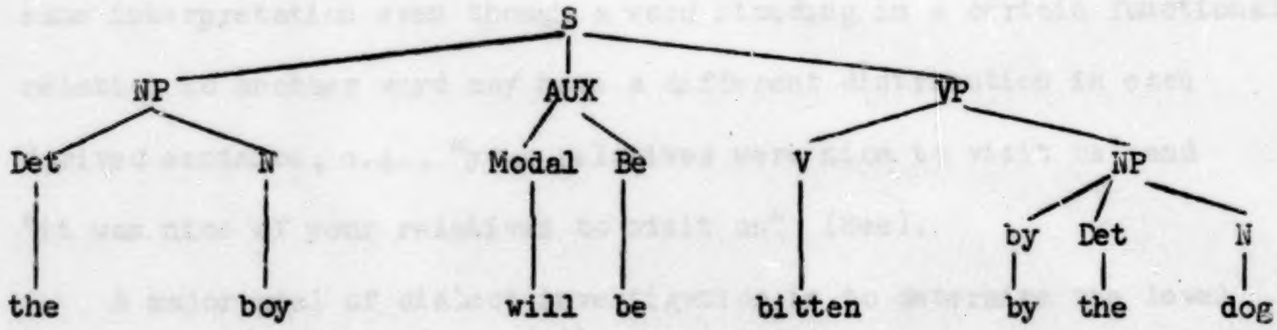
Transformational grammar is an attempt to represent the linguistic knowledge which a speaker must possess in order to utter and comprehend the infinite number of sentences in his language. The fact that no one can learn a language by memorizing all of its sentences requires that the speaker's knowledge, the grammar of his language, consist in part of a finite set of recursive rewriting rules of the form A--->+C, C--->A+D. Applied over and over again, i.e., recursively, these rules produce an infinite set of sentences like BAD, BBCD, BBADD, and so forth. To the extent that rewriting rules are capable in principle of enumerating all and only the sentences of a given natural language, we can approach the problem of language learning on the reasonable assumption that a child develops a finite set of rules which permit the realization of an infinite number of sentences.

Other aspects of linguistic competence, such as the ability of the speaker to determine when two sentences are synonymous, suggest that the grammar must contain certain machinery in addition to rewriting rules. Let us suppose that the grammar generates independently the two sentences "the dog will bite the boy" and "the boy will be bitten by the dog." The output and the derivational history of the rewriting rules can be graphically represented by tree diagrams or phrase markers.

(1)


S
NP
AUX
VP
Det
N
Modal
V
NP
Det
N
the
dog
will
bite
the
boy

(2)


S
NP
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the
boy
will
be
bitten
by
the
dog

In both sentences produced in the above phrase markers "the dog" is interpreted as having the subject-verb relation to "bite." Similarly, the verb-object relation obtains between "the boy" and "bite." Since these relations are not associated uniquely with the positions of "the dog" and "the boy" in the phrase markers, and since any significant grammar must explain the speaker's ability to make such associations, we are forced to postulate a more abstract structure underlying the two sentences, one on which functional relations are uniquely defined. More specifically, we postulate an underlying phrase marker, generated by rewriting rules, which resembles (1). The subject-verb relation can be defined uniquely as the function NP of S and the verb-object relation as the function NP of VP. Phrase marker (2), however, is not generated independently. Rather it is derived by a mapping or transformational rule which converts phrase marker (1) into phrase marker (2). The syntactic component of the grammar is thus bifurcated into a set of rules producing underlying phrase markers on which functional relations are defined and a set of transformational rules which map underlying structures onto surface structures. The way in which a sentence is understood is determined by the material in the underlying structure. Thus different surface structures derived from the same underlying structure necessarily receive the same interpretation even though a word standing in a certain functional relation to another word may have a different distribution in each derived sentence, e.g., "your relatives were nice to visit us" and "it was nice of your relatives to visit us" (See).

A major goal of dialect investigation is to determine the level on which dialects differ from one another. Do dialects of English differ only on the surface level, i.e., in the transformations mapping underlying structure onto surface structure, or are their underlying structures distinct? To date there has been no transformational research to speak of in syntactic dialectology, but we might consider the kind of data which could be found. Consider the following three sentences as representative of different dialects.

D-1 Johnny hates it for his father to spank him

D-2 Johnny hates for his father to spank him

D-3 Johnny hates his father to spank him

For reasons which are independent of the above examples, the grammar of English must contain the following transformational rules (see):

Rule 1 Separate "for" from "to" when the "for-to" configuration appears as the auxiliary in a complement of a noun and the head noun has not been deleted, e.g., "the plan for Bill to come."

Rule 2 Delete "it" before a sentence. Thus, from the underlying structure "I think it that Johnny is smart" we derive "I think that Johnny is smart." Note that "it" is not deleted when it does not immediately precede a sentence as in "it is thought that Johnny is smart."

Rule 3 Delete "for" when it immediately precedes "to." When "for" is not separated from "to" by Rule 1, as in "I ordered Billy for to come," the "for" must be deleted giving "I ordered Billy to come."

Employing these rules, the three dialects can be described quite simply in terms of rule ordering or non-application. For instance, for D-1 Rule 1 applies, Rule 2 is non-applicable in this dialect, and Rule 3 cannot apply if Rule 1 precedes it. For D-2, Rule 1 applies, then Rule 2, and Rule 3 again cannot apply. For D-3, Rule 2 applies first. Rule 1, therefore, cannot apply and Rule 3 must apply.

Similarly, for the case of copula absence recorded by Labov and Bailey (See), it is not necessary to postulate that this dialect differs in underlying structure from standard English. Indeed, this is false since the presence of the copula in the underlying structure must be assumed in order to account for its presence in past tense and question constructions. The absence of the copula suggests an extremely low-level transformational rule which deletes the copula when it occurs in active non-negative present tense sentences.

The transformational approach to dialect study permits a precise and insightful characterization of the relatedness between grammatical systems. Although it is still too early to discuss the meaningfulness of the definition of dialects as differing from some real or imaginary standard language only in the transformational apparatus which derives different surface structures from common underlying structures, the examples discussed earlier suggest that syntactic dialectal variations are not as deep in the linguistic system as they might appear. The transformational approach also allows investigation of the constraints on dialect divergence. Assuming that dialects differ only on the transformational level, it is unlikely that all possible alterations in the transformational machinery are to be found, e.g., the non-application of all transformations. It is not inconceivable that dialect difference does play some role in learning to read. But prior to this question comes the need to develop a motivated methodology for describing and relating different linguistic systems. The results of transformational linguistics can provide the kind of knowledge which must be a prerequisite for a significant dialectology.

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PRELIMINARY OUTLINE OF PILOT STUDIES ON RELATIONS OF COMPREHENSION AND SPEECH IN PRE-SCHOOL CHILDREN

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A much-needed "New Look" in studies of child language learning, characterized by the work of such people as Roger Brown and his associates, Susan Ervin and Wick Miller, and Martin Braine, has emphasized the creative and original aspects of the child's learning, and have minimized the role of imitation, the traditionally overburdened explanatory device in this field. While this change in emphasis has been salutary, I should like to return to the study of the child's imitation of language in order to elucidate (1) its role as an aid in the acquisition of syntax and semantics, and (2) some of the determinants of early telegraphic speech, especially the relationship between speaking and understanding.

The age range of interest is roughly between 18 and 30 months--a most difficult age at which to secure the cooperation of subjects. The long-range goal of the investigation is the longitudinal study of a number of children in their homes. This phase will be preceded by pilot work with two-year-old pre-schoolers in order to develop comprehension tests, and to explore relationships between characteristics of model sentences and their repetitions by children.

Spontaneous Imitation and Expansions

In the course of a day at home a little child spends much of his time repeating the speech he hears around him. One cannot generalize about the role of this imitation, since it clearly serves many functions, but at least some of these functions seem to be related to language learning. Of special interest is the nature of a child's response to adult imitations of his own speech--what Brown and Bellugi (1) have called "expansions." The telegraphic speech of children of this age is often filled out by immediately following adult interpretations. I have observed that children frequently imitate such adult expansions of their speech, and that, in these imitations, the child can often expand his original utterance to the limits of his usual productive capacity, or a little beyond those limits. The child's imitation of expansions of his own speech may play an important role in grammatical and semantic learning.

In this research I will be interested in finding out something about the different ways in which mothers use, and children imitate, expansions. I will want to know how imitations and expansions are used at various stages in the child's linguistic development and to study expansion and imitation between siblings. In visiting homes, I would also like to try acting as an expander myself doing a lot of expanding, to see what sorts of expansions tend to be spontaneously imitated and observing the children's reactions to obviously incorrect expansions.

At the same time, following closely several children between the ages of 18 and 30 months, I will be interested in studying relationships between what they can imitate and what they can understand. The same sorts of sentences can be presented again and again to discover the order in which new elements are added to repetitions. Other tests can continually test the comprehension of those elements.

Comprehending and Speaking

Animals, little children, anarthric children (3) and others, can respond appropriately to linguistic utterances which they themselves cannot produce; it has long been affirmed that growing children can understand linguistic forms which are not yet part of their own speech. Fraser, Bellugi, and Brown (2) tested this assumption with three-year-old children. Defining comprehension of sentences in terms of correct identification of pictures of their referents, and defining production in terms of uttering appropriate sentences in regard to pictured referents, they found comprehension to be more advanced than production. However, if production was defined in terms of imitation of sentences, it was found that children could imitate sentences which they could not understand. This latter finding implies that a child need not understand a sentence in order to imitate it correctly.

However, the work of Menyuk (5) with nursery-school and kindergarten children, and the work of Lenneberg et al. (4) with mongoloid children, suggests that there is a close relation between the grammatical complexity of a sentence and a child's ability to repeat it correctly. These studies imply that in order to reproduce a grammatical form one must first have some ability to produce it on one's own.

These apparently incompatible implications can be reconciled if one distinguishes between uncomprehending and comprehending imitation. If a sentence is short enough to be held in immediate memory, it can probably be echoed back--played back out of the "echo box," as it were. This is probably what was found by Fraser et al.; the sentences used in their experiment were short enough to be echoed back by three-year-olds. Sentence imitations of two-year-olds, however, tend to be "telegraphic"; that is, the child will generally repeat some of the main content words (in their proper order), and leave out inflections (plural, possessive, etc.) and function words (articles, prepositions, auxiliaries, etc.). These are the very items upon which the comprehension of the sentences used by Fraser et al depended. It is still an open question whether children who omit these functions can understand them: this is one of the questions to be investigated.

Comprehension tests are being developed in order to discover whether the child can understand the elements missing from his telegraphic speech--whether he can process more material in decoding than he can in encoding. I have been working with two basic sorts of comprehension tests--object manipulation and picture identification. For example, a child can be given a toy car and a toy train and asked to show "the car is pushing the train," "the car is getting pushed by the train," and so on. In order to test the understanding of a preposition in the absence of other cues a child can, for example, be given a block and a box and be told to "put the block on the box." If his imitation of this sentence is telegraphic, he can later be asked to imitate and show comprehension of re-arrangements of the sentence: "Put on the box the block"; "Put on the block the box"; "Put the block the box on"; etc.

Another sort of comprehension test being developed involves hiding a toy under one of two or three boxes, and describing its location in terms of objects placed on the boxes--for example, "the box with the car," or "the box with the cars."

I will also experiment with picture tests of the type used by Fraser et al.

The following are among the grammatical features being investigated: prepositions (in, on, under, next to, between), indefinite and definite articles, singular and plural (noun and verb inflections), affirmative and negative, possessive, active and passive voice (standard, and the colloquial "got" + participle), and a variety of conjunctions, conjunction deletions, and elliptical sentence patterns.

It is also of interest to discover how well a child can understand his own language at a later time. He can be asked to tape-record instructions, or descriptions of similar pictures, and his comprehension of these recordings can then be tested.

Signal Determinants of the Child's Linguistic Competence

It has been suggested that characteristics of the linguistic signal itself--chiefly its stress and intonation patterns--determine which elements the child will hear and understand. An attempt will be made to untangle a number of these suggestions by experimenting with a variety of sentence models presented for repetition to two-year-olds.

For example, it has been proposed that one reason a child's imitations are telegraphic is because he does not repeat unstressed words. Accordingly, I will present sentences for imitation in which stress patterns are changed.

It has been suggested that function words are omitted because they are redundant and meaningless. Sentences will be presented for imitation in which the placement of function words is shifted, and in which function words are replaced by nonsense words. It is also possible to present sentences for imitation in which it is meaningful to stress the function words--for example: "The ball is not in the cup. The ball is on the cup." It is thus possible to compare the effects of stress alone, and stress in combination with meaning, in the imitation of elements normally omitted from the child's speech. In the latter case, it is also possible to ask whether imitation will be improved if the referent objects are present, giving the child something to hold in immediate memory and perhaps allowing him to generate a longer sentence in repetition.

In order to examine the proposition that meaningfulness and familiarity determine the words selected by a child for repetition, Jabberwocky-type sentences, in which only the function words are familiar, can be presented for imitation.

* * *

In the course of the coming year I hope that many of these rough porposals will be sharpened up.

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LANGUAGE SKILLS IN THE CONTEXT OF THE CHILD'S COGNITIVE DEVELOPMENT

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In order to understand the processes that underlie the child's acquisition of language skills, in general, and reading in particular, it is essential to consider these functions in a broad framework including non-linguistic aspects of cognitive development. To this end, we will first draw an outline of the child's mental development, and then attempt to see how language fits into the picture.

Child Dominated by Immediate Stimuli

The main thesis to be put forward is that the child's behavior is governed more intensely by the effects of immediate stimuli than by ideational processes such as sets, rules, and plans. Evidence to support this thesis will be cited from the works of Luria, Bruner, Vygotsky, and from free association experiments.

Luria's work on the role of language in the regulation of beahvior. Luria (1961) studied the relative powers of immediate stimuli and ideational processes in situations where these two factors lead to competing responses and found that the immediate stimuli dominated. In one of his investigations, for instance, he found that children four or five years old could be regulated by an initiating instruction, such as "Start squeezing the balloon," but not by a cessation instruction, such as "Stop squeezing the balloon," Rather than achieving its desired effect, the latter-type instruction would intensify the on-going activity. Apparently, an instruction can exert an effect when nothing in the child's immediate environment opposes it, but does not yet have the power to counteract the influence of the activity in which the child is engaged.

Bruner's work with conservation tasks. In a typical conservation experiment, a child would be shown two equal-sized beakers filled with water to the same level. The water of one beaker would then be poured, in the sight of the child, into another, narrower or wider, beaker. To the question if there was the same to drink in the new beaker as in the beaker that remained filled, the child's answer would usually be "No." Bruner (1964) reports a variation on this procedure which highlights the interpretation that the child does possess the notion of volume conservation under transformations in the shape of the container, and his failure to manifest conservation is due to the competing effects of the visual stimuli. Instead of allowing the child to see the new beaker, it is covered from his view by a screen, and the child watches the pouring operation. Under these circumstances, his answer to the standard question is: Of course it is the same, you just poured it. If the screen is now removed many children will change their minds and insist that the two beakers do not contain the same amount of water because the water comes to different levels. The failure of the logical rule to shield the child from the compelling effects of the appearance of the visual displays is probably due to its relative weakness at this stage of development.

Vygotsky's work on children's semantic system. Vygotsky (1962) characterizes children's modes of grouping as complexive. When asked, in an experiment, to put with a sample block, all the blocks that go with it, children would form chains where only neighboring blocks shared attributes. For instance, a green triangle may be placed with a blue triangle and then a circular block, which does not share any feature with the green triangle, added. The switch from one basis of grouping to another seems to reflect the child's inability to be guided by a single principle under varying influences of immediate stimuli.

Children's associations. It has been observed that children's free associations differ from those of adults. Adult responses were described as paradigmatic, or homogeneous with respect to part of speech, and children's associations as syntagmatic, or heterogeneous with respect to part of speech. An adult would generally respond to a noun with another noun (man-woman), to a verb with a verb, etc., while a child is likely to associate a noun with a verb (man-work) and a verb with a noun (go-home). The label syntagmatic gives the impression that children's associations are guided by the grammar of their language. It is proposed here that this inference is misleading and that the distinguishing feature of a child's associations is the relative absence of any general guiding plan, be it a rule of grammar or anything else. Rather, the child responds to each word on the basis of immediate impressions arising from the word and other aspects of the environment. In his associations as in other aspects of his behavior the child is stimulus-bound. His responses are pragmatic rather than syntagmatic. The present interpretation is amenable to experimental test. If sets or plans do not exert a strong guiding effect on the child's responses, then experimental manipulation of instructions should produce smaller variation in the responses than manipulation of the stimuli.

Cognitive Development and Language Development

The child's cognitive behavior can thus be characterized as submissive to sensory stimulation and disrepectful of the authority of plans, guiding principles and rules. Yet in the area of cognitive behavior there seems to be an exception to this general trend: in his speech, the child appears to obey more or less slavishly the rules of grammar of the language he is using. As was shown by Chomsky, such obedience entails competence in a system of very abstract structures of linguistic units and rules for their combination and transformation. The discrepancy between the level of syntactic functioning of the child and his stage of development in non-syntactic cognitive behaviors. including the semantic component of language, demands some attention.

One possible solution to this problem is to postulate a specialized device for analysis of linguistic input, the kind of device envisaged by Chomsky (1962) and termed "universal language-learning device." According to this hypothesis, the device is specialized because it is adapted only for the processing of linguistic data whose output is the grammar of the language and is not competent to deal with other data. This is not an unreasonable hypothesis in view of the observation that people who in other behaviors exhibit a low level of cognitive development, can, apparently, speak their native tongue as well as acquire other languages with great ease.

An alternative hypothesis would turn the tables around and claim that even grammatical rules are not strong enough to counteract the effects of immediate stimuli. Thus, for instance, a child who is able to produce the past tense when the situation calls for it, may not be able to do so when stimuli indicating presentness act upon him, as when he is looking at a picture depicting an on-going activity. Research in this area would contribute to our understanding of the place of language in the over-all framework of cognitive development.

Cognitive Development and Reading

In learning to read, the child has to form a relation between orthography and speech. One would suspect the establishment of a relation between these two systems to be affected by the nature of the relation for the child between speech and reference.

The scanty evidence available supports the notion that for the child words and objects are more closely associated than for adults. Vygotsky (1962) reports experiments where children would not permit the word-names for objects to be interchanged. If replicated, these results may mean that the word for the child is not unlike a picture of the thing. Certainly, even adults would object to representing a cow by a picture of a pencil, and a pencil by a picture of a cow. This interpretation is consistent with Bruner's (1964) characterization of the child's representational system as iconic rather than symbolic and with Piaget's (1955) observation that children abhor arbitrariness and attempt to "justify everything at all costs." How could a child who cannot permit arbitrariness conceive of a word as an arbitrary sign attached to an object?

The manner in which writing represents speech is based almost exclusively on the properties of speech and the association between speech and reference has little relevance to the way in which speech is coded in writing. The fact that the word "chair" refers to a sit-on-able rather than an eat-off-able object has no bearing on the spelling of this word. In reading, "chair" falls into one category with "child" on the basis of its initial sound, and another category with "fair" on the basis of the middle and final sounds. Obviously, the referents of these words do not fall into common categories. Thus, when a child learns the code for a phonetic orthography he has to maintain a set of responding to the auditory properties of words. Of course, when the constellation of stimuli arouses him the child does spontaneously respond in this manner, as evidenced by his rhyming activities. But the present question is whether the auditory set can gain control over the child's responses so that he is consistently guided by it even when the immediate stimuli are not favorable. It seems that such an unfavorable situation may arise when pictures are present in the reading text thus emphasizing the referential aspect of the words.

Additional complications in the reading task may be due to the fact that in order to understand what he is reading the child has to attend simultaneously to two competing sets, the auditory and the semantic set.

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A STUDY OF SEQUENTIAL SPEECH IN YOUNG CHILDREN

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Problem:

The ways in which humans selectively filter, internalize and transform the continuous stream of stimuli impinging upon them is of central concern to the psychologist. He is practiced in examining input-output sequences under a variety of physical and social condition and at guessing at the characteristics of organizational processes which occur within the organism under these conditions. Yet, while human speech is one of the most abundant of the inputs affecting socialized man, the behavioral scientist has devoted little attention to the organizational processes involved in the reception and storage of sequential speech. In fact, the greatest part of the research in verbal behavior has focused upon input-output sequences in which isolated words were used as stimuli.

Since words seldom occur in isolation under natural circumstances, the relevance of this kind of research to the manifold theoretical and applied problems of language acquisition is brought into serious question. The need for fresh approaches in the study of language acquisition is of particular urgency at present. The behavioral scientist increasingly faces the responsibility for developing programs to help solve the problems of semi-literacy and related difficulties of those whose language skills are less than adequate to meet the demands of a highly technical society. To do an affective job of planning and developing, he needs a systematic body of knowledge about language acquisition which is more directly relevant than that currently available.

The projected research program offers a new approach to the study of language by concentrating on the processing of sequential speech. An attempt will be made to further develop a series of techniques now being explored.

Study:

The retelling of stories has been found to be a promising method in the study of sequential language. For the study of children's language, stories as "input" material are a natural. Investigators in that area have long assured us of the importance of "being read to" in the acquisition of proficiency in language. The proposed program of research will examine the variation in children's language as a function of certain types of (a) experimental and (b) instructional conditions. By examining the transformations that the stories undergo when retold by children, we should be able to uncover patterns of variation for children with varying degrees of experience with language. Thus models of underlying organizational structures involved in storage and recall may be inferred.

A group of four-year-olds (size of sample at present undetermined) entering pre-school programs will serve as subjects. The sample will be drawn from the lowest socioeconomic levels.

a. During the early sessions of story retelling, the effects of these experimental conditions will be investigated:

1. Different story readers, with whose phonological patterns the child has varying degrees of familiarity

2. The presence or absence of pictorial cues from the story book during the reading and/or during the retelling period

3. Varying time lapses from reading to retelling

4. Single presentation of the story and single retelling vs. multiple retelling of the same story

These variations in the simple retelling design will be introduced to discover changes in the organizational processes assumed to underlie the reception, storage and recall of the stories read to the children.

b. Projected analyses: Only a few children and adults are able to recall verbatim long sequences of language.[1] For most adults recall involves some modification of the original account. Thus it seems reasonable to assume that during the process of 'internalization' (while the text is being committed to memory), what has been heard undergoes some form of simplification into a sequence of key words and concepts. During recall, it is this internalized and probably simplified version of the original story which is re-expressed in communicative language.

The primary emphasis in this study will be on elucidating the cognitive and organizational features of the retold stories. During the preliminary research we have found that the retold stories reveal a variety of patterns: some were almost verbatim accounts of the original; others were well sequenced but with no logical relationships between episodes. Some were highly logical, but revealed great variations in the actual wording; others were imaginative but in jumbled sequences.

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[1] To date, the book which has been used in the story re-telling sessions is Curious George, by H. A. Rey. Almost all the children in our current studies would recall phrases such as "the houses looked like toy houses and the people looked like dolls," while statements concerning the internal states of the 'hero,' e.g., "George was frightened," were rather uniformly omitted by the six-year-old children we have been working with.

Comparing the input story with the variations in re-told stories should suggest models of the organizational processes underlying these modifications. The use of pictures during the reading as well as the retelling of stories has focused our attention on some of the "iconic" features of children's cognitive processes. The proposed variations in the method of presentation will allow a closer examination of a greater variety of organizational processes involved in the reception and storage of sequential speech.

Attention will also be given to exploring characteristic phonological features of the children's speech. Labov in his study of New York's multiracial residents of the Lower East Side[2] found certain phonological features to be highly consistent among the Negro speakers, except for those who had no Negro friends during their formative years. In this study the influence of various environmental conditions will be examined effecting the phonological and cognitive features of children's speech, included among these are the opportunities of young Negro children to associate with white peers, and/or white teachers.

The examination of these samples will be in terms of characteristic features, to include:

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[2] Lebov, W. Phonological Indexes to Social Stratification. Paper read at the 62nd Annual Meeting of the American Anthropological Association.

1. phonological features (e.g., voicing-devoicing deviations, deviant stress and intonation contours, phonemic confusions and omissions)
2. morphological features (e.g., overgeneralization of present tense verb forms and related problems which may result from either phonological or morphological confusions)
3. organizational features (e.g., adequacy of presentation, in terms of inclusion of relevant details from the story, effectiveness of sequencing and transitions)
4. hesitation phenomena, including correction patterns (e.g., repetitions, syntactic reversals, stuttering, false starts, etc.)
5. error patternings (e.g., consistency in misuse of lexical items, syntactic deviations, etc.)

These analyses will be related to the various ways in which the original story was presented, and then transformed in the process of storage and retelling. For instance, when the story is read by an older sibling, with whose dialect the subject is familiar, does the child recall a greater percentage of the original words than when his teacher or a white examiner reads to him? Or, how much of a modification takes place in context and/or wording with multiple retellings?

c. Changes in speech patterns as a function of different instructional conditions. An attempt will be made to choose children about to enter into pre-school programs of the following compositions:

1. The teacher as well as the children are drawn from the low socio-economic Negro neighborhoods of the city.
2. The teacher is white and presumable middle-class, the children are drawn from the same setting as above.
3. The teacher is white and the children represent a heterogeneous group in terms of ethnic membership and social class.
4. Same as above (3) but the teacher of this mixed group is Negro.

The four groups of children will have story retelling sessions before their first year of pre-school, or kindergarten[3]; and at the completion of their first year of schooling. Some record will be kept of the degree of association of children from varying backgrounds in the heterogeneous class.

A comparison of group trends will be made in the changes which occur during story retellings. We expect that striking phonological changes will take place in the youngsters in the heterogeneous group. The major question, however, is: Will these phonological changes be accompanied by major cognitive changes, or will the cognitive changes be of the same magnitude as those which characterize the children in the other settings?

3/ In case we have difficulty locating pre-school programs with a heterogeneous composition, or in case the technique of story telling is found too difficult for four-year olds, we will use kindergarten children who have not attended pre-school programs.

THE VALIDITY OF PAUSE AS AN INDEX OF UNITS IN LANGUAGE*

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A series of five experiments was carried out to assess the validity of pause in speech as an index of unit boundaries in language. The criterion for the existence of a unit was resistance to fracturing. It was hypothesized that portions of utterances segregated by pauses would behave as units--i.e., resist fracturing.

The general procedure was similar for all of the experiments. Undergraduate freshman and sophomore girls learned versions of stories or word lists, depending on the experiment. All of the stories or word lists were presented to the subjects in a monotone from a tape recorder. The stimulus material was repeated before each trial, and the trials continued until the learning criterion was achieved. The subject's output was taped in every instance.

The subject returned for a second session either 24 hours or one week later, depending on the experiment. In the second session, the subject's first task was to recall the first story (or list) she had learned in the first session. The primary purpose of this recall was to provide some control for difficulty differences in the stimulus material and for differential impact of time on the subjects.

The recall of a story or list was followed by the experimental condition in which the subject learned a mutilated version of the material she had learned in the first session. The general procedure

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* This work is supported by NIH Grant MH-07226.

used in manufacturing the mutilated versions was as follows: Verbal stimulus material learned by the subject was fractured into parts in two different ways--at points where the subject paused, and at points where there was no pause. The parts thus obtained were placed in a random order forming two new sets of verbal material which the subject was required to learn. According to the hypothesis, it should be easier to learn the mutilated version which contains parts obtained by fracturing at pauses rather than at no-pause positions.

In every experiment, it was more difficult to learn the material constructed from the non-pause fractures. The same result was found for both narrative and for non-narrative material (which was minimally syntactically organized). The result persisted when the non-pause material for one subject was another subject's pause-fractured material (the switch-pause condition). This latter result was replicated in three of the experiments and indicates that pause is sensitive to individual differences in how verbal material is organized.

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REPORT OF THE

THIRD RESEARCH PLANNING CONFERENCE

"SOCIOLOGICAL FACTORS IN THE STUDY OF READING"

Held Under the Auspices of

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Project Literacy

The Child's Acquisition of Grammar[1]

Roger Brown, Ursula Bellugi,
Courtney Cazden, & Gloria Cooper

For two years we have been conducting a longitudinal study of the development of English grammar in three children from the age of 18 months until 42 months. The primary data are transcriptions of child speech and of adult speech to the child; some 4 to 6 hours of such interaction are taken in the course of each month. Two of the children being studied (Adam and Eve) have college-educated parents while the parents of the third child (Sarah) have not completed high school. The project aims at describing the normal progression by which children learn English grammar and also the determinants of this progression.

Mrs. Bellugi described the techniques of data collection and analysis used in the cases of Adam and Eve and Dr. Cooper the procedures used with Sarah. The important difference is that the speech of the first two children is transcribed on the morphemic level while a narrow phonetic transcription, including supersegmental features, is being used for the speech of Sarah.

The group has most recently been working on the child's operations on the English verb. In all 3 children the first verbs are uninflected main verbs (*walk*, *want*, *see*, etc.). In both Adam and Eve the verbal inflections develop in the order: progressive, past, third-person present indicative. The catenatives (*wanna*, *gonna*, *hafta*) precede the modal auxiliaries (*will* and *can*). In general, kernel sentences precede well-formed negatives and well-formed "yes-no interrogatives" and all of these precede well-formed "what and who interrogatives." The third child, Sarah, is far behind the other two but her first few operations on the verb are, as they were with Adam and Eve, the progressive inflection and the addition of catenatives.

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[1] This is a preliminary report not to be quoted without permission. The work is supported in whole by Public Health Service Research Grant MH-07088 from the National Institute of Mental Health.

Progressive forms of the verb are at first produced without any *be* form (e.g., *I going*). There appears to be a normal progression for the addition of the *be* forms (*am*, *is*, *are*) to the progressives with pronoun subjects (*I am going*, *He is going*, *It is going*, etc.). The *be* form is used with the impersonal pronouns (*it*, *this*, *that*, *these*, *those*) before it is used with the personal pronouns (*I*, *he*, *she*, *we*, *you*, *they*). Even among the individual pronouns of a category there is a nearly invariant order for the addition of the *be* form.

(Brown)

For these three unacquainted children the order in which constructions appear is strikingly constant. However the rates of progress are quite different. Eve is about 10 months ahead of Adam and Adam about 6 months ahead of Sarah. We have found it convenient to express a child's level of development by mean utterance length or by an imitation ratio. From the child's level on these indices it is possible to predict correctly many features of his grammatical development.

At least two kinds of learning seem to be involved in the acquisition of the operations on the verb. The frequency of each construction in a child's speech was compared to the frequency of the same construction in the mother's speech for every sample. One might have expected each construction to rise gradually toward the mother's (rather stable) level. However many constructions (for example, the progressive inflection and the use of catenatives) rise sharply to a level several times that of the mother and then very gradually fall down toward the mother's level. These curves suggest the acquisition of a rule and a period in which the rule is over-exercised. However, the acquisition of some features looks quite different. For instance, the be forms which are not at first used in the progressive are very slowly learned. For many months the child will oscillate between supplying the form in contexts where it is required and omitting it. In immediate succession, for instance, he may say: She going and She's going. Very gradually the expanded form replaces the telegraphic form. We think these redundant auxiliaries are learned by a sort of verbal conditioning rather than as rules.

Three kinds of determinant of acquisition interest us at present. The first is the relative frequency of a construction in the speech of the mother to the child. There are great differences of frequency among the constructions for a given mother. However the frequency profiles of the mothers are extremely similar; the correlations range from .65 to .92. There is about the same degree of similarity between different mothers when their children are the same age as there is between two profiles of the same mother taken at different times (up to about 6 months). It looks as if there is a standard form of mother-to-small-child English and this English is a very special restricted sample of the possibilities in the language. The frequency profile is an important determinant of the order of acquisition of grammatical operations. But it is not the only determinant.

Frequency in the mother's speech has proved to be closely related to grammatical complexity. For example, negative transformations and "yes-no interrogative transformations" are both much less frequent than the respective kernel sentences. The "who-what interrogative" transformations which are more complex than the "yes-no interrogatives" are in addition, less frequent. Some aspects of the progression observed in Adam and Eve are, as a consequence of these natural correlations, predictable either from frequency in the mother's speech or from grammatical complexity. The correlations remind us of G. K. Zipf's ideas about word length and frequency. It looks as if we use simpler grammatical machinery for constructions that must often be used.

Finally there is the frequency with which the mother "expands" a child's telegraphic version of utterance into a well-formed complete version. A telegraphic utterance is expanded by adding to the content words he speaks those functors (articles, prepositions, inflections, conjunctions, pronouns, and auxiliary verbs) which will result in a simple sentence appropriate to the total situation. We have found that Sarah's mother does much less expanding than do the mothers of Adam and Eve and this difference in tutorial practice may account for Sarah's slower rate of development. However in the natural case at home expandsions tend to be correlated with the simple production of well-formed model sentences. Mrs. Cazden has begun an experiment to separate these factors in a Day Care Center in Roxbury, Massachusetts. Children of one group are to be given intensive and deliberate expansion training; children of another group will have an equivalent exposure to well-formed sentences not produced as expansions and a third group will receive no training. There are to be daily tutorial sessions over a period of 4 months. We expect exposure to well-formed sentences to produce an improvement over no training and expansion training to accomplish even more.

There are semantic rules for most of the operations on the English verb that Adam, Eve and Sarah are using. It seems quite clear that full understanding of the meanings of these operations does not precede their use. In the first place a child may use a form very often and have been using it for months and yet he will not always use it in circumstances where it is clearly required. In the second place, the range of usage only gradually approaches the adult range. For example, the future is at first a kind of "intentional" form used for any action the child is just about to perform but not used for more remote future actions. Similarly the reference time for the present progressive is always narrowly calculated as the time of the utterance; not as this year or this month. We expect expansion training to improve semantic control as well as syntactic control.

THE READING READINESS NURSERY SCHOOL

Fred L. Strodtbeck
University of Chicago

The Reading Readiness Nursery School involves the four-year-old children of Negro families receiving Aid to Dependent Children. In most cases the father is absent from the home. To date we have conducted eight sessions, each class containing about ten children. Each session lasted approximately thirteen weeks. The nursery school enables us to study the children's response to our training efforts through tests and behavior ratings made by the teachers, and their mothers through interviews. Some experimentation with teaching techniques is a part of each session.

Despite the wide variation in the teaching techniques used, the children in almost all groups gained significantly in both Stanford Binet IQ (an average of five points) and Peabody Picture Vocabulary Test IQ (an average of 14 points). The only groups which failed to benefit were the most "radical"--one in which we experimented with the mothering of individual children (a procedure which caused sibling rivalry problems) and one in which all group leadership came from the children themselves.

The basic dilemma in welfare allocation is the tension between the desire to give to each according to his need and the actual situation, which is often "Them who has, gets." We might hope that the less prepared students would be brought up to par when in fact, the gap between the less and better prepared students might have been widened. Fortunately, this was not the case. The correlation between initial IQ score and gain in IQ (Stanford Binet) was -.64. Those children with IQ's below 80 gained an average of ten points, those with IQ's between 80 and 100 gained from three to six points, and those with IQ's over 100 gained not at all. It appears that the immutability of the higher scores means that these children suffered to a lower degree from the kind of deprivation which might be corrected by the Nursery--but beyond this near platitude, we don't understand fully why we got the response we did. We plan some further item analysis.

Further evidence of relationships between gain in IQ and deprivation came from some information on the mothers' child rearing which was obtained by Mrs. Mildred Buck of our staff. Mrs. Buck gave the Sears, Maccoby and Levin child-rearing interview to most of our mothers and compared their responses with the SML norms. Factor analyses of these data yielded the following factors:

1. Strictness--i.e., high standards on eating all food,

using good table manners, and going to bed on time, along with severe toilet training.

2. Verbal vs. Physical Means of Control--the use of praise and reasoning, rather than physical punishment. (Our mothers tend to be low on these scales as compared with the SML sample.)

3. Non-Acceptance of Dependency--i.e., the mother does not find time to play with the child, is not affectionately demonstrative, and does not tolerate dependency. (Our Negro ADC mothers tended to be high on this factor.)

4. Stable vs. Father-Absent Family. In the stable extreme the father is actively involved in child care and discipline and is highly esteemed by the wife, and the wife is pleased with her situation in life. (Our mothers are generally low on this factor.)

Three of the four child socialization factors correlated with IQ gain as follows:

Initial r		Multiple R^1
.27	Verbal v. Physical	
.10	Non-Acceptance of Dependency	.38
.22	Stable v. Father-absent Family	.45

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[1] After entry of variable on the same line.

(Strodtbeck)

Thus, if a child has had a mother who used verbal techniques, he gained more from the nursery experience. This is an instance in which an earlier experience parallel to the training techniques of the nursery has fitted the child to profit more from the school experience. Although Factors 2 and 3 were correlated -.48, both were positively correlated with gain. It was the child whose mother didn't play with him, who was not demonstrative or accepting of dependency, who gained. Similarly, the child with the absent father gained more. Thus, for the first variable the verbal emphasis of the home enabled the child to gain from the nursery, but for the second and third most important variable, the nursery operated to compensate for deprivation.

Sociometric data on the children was obtained by showing them pictures of all the children in the group and asking them to show who they liked and didn't like. The sex of the child was an important determinant of his sociometric status. For the 24 boys and 28 girls for whom data are available, girls were favored two to one:

		To	
		Boys	Girls
From	Boys	9	15
	Girls	8	20

Since virtually all of the children came from father-absent homes, it might be desirable to have a program in the nursery which would improve the relative sociometric status of the boys.

Since being liked by others is quite different from gain in IQ, we were particularly interested in determining which child-rearing factors were relevant. The most important factors, in order, were (3) Non-acceptance of Dependency (the more warmth received by the child at home, the more he was liked by his nursery mates), (4) Stable Family, and (1) Strictness. These three factors, together with sex, produced a multiple R with sociometric status of .46 (p less than .01). Thus, to an unusual degree gain and sociometric status were unrelated, or negatively related, as shown by the relationships between them and the socialization factors:

	IQ gain	Sociometric status
Verbal (v. Physical)	positive	0
Strictness	0	positive
Acceptance of Dependency (& warmth)	negative	positive
Father absence	positive	negative

The behavior ratings made by the teachers shed further light on the sociometric scores. "Leadership"

(Strodtbeck)

as judged by the teacher correlated a significant .45 with sociometric score. Quite surprisingly, the child judged to be "clinging" was more generally liked, and the "aggressiveness" of the child was inversely related to being liked--perhaps, to a greater degree than would have been the case in a middle-class nursery.

Some Observations of the Learning Environment of the Child Growing up in the South End of Boston

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Current research studies of families of middle-class children with neurotic learning inhibitions have emphasized three characteristics of the child's environment which seem to contribute to the pathology. The first is the existence of disturbing and chronic familial situations, to which the child is exposed, and which arouse considerable anxiety in the members of the family. The second is a preference on the part of the parents to handle such situations with the child by secrecy, deception, distortion of reality, or by other such devices of communication which seriously discourage the development of intellectual or cognitive modes of defense in the child. Closely akin to these first two conditions is the tendency on the part of the parents to see active independent intellectual development in the child as threatening, and to react by derogating the child's learning ability.

Research into these, and other factors, in the milieu of the culturally deprived child in the South End of Boston, is anticipated. The first year of this project has been devoted to good working relationships with the settlement houses, churches, indigenous community leaders who are the best source of information and introduction to the community. Students in our clinical training program have done diagnostic testing, short-term treatment, tutoring, nursery school work, school and court consultation, and work with mothers' groups. The following observations, which may or may not be valid generalizations, have been formulated:

(1) The area is not socially homogeneous as would be implied by the term "lower class." There are easily accessible cooperative families who have values around moral behavior and education (of the fundamentalist religious variety rather than intellectualized ones) but who often have difficulty putting these into effect with their children. There are other families more disorganized, difficult to contact, suspicious and uncooperative, who rarely come into contact with the agencies on a voluntary basis and about whom we know much less.

(2) The families are often run by the mother who is seen as far more stable in the child's life than the father, and who in turn may rely on her own mother for support and help. Mothers are often overwhelmed by day-to-day pressures and lack energy to devote to their children, despite the fact that they may often have concerns about their development. This concern seems to be around the conduct of their children for which they feel most responsibility (and about which they are most often called into court) rather than learning which is considered the responsibility of the school.

(Brodie)

(3) Verbal communication with children is used to control, punish, or express affect rather than to aid the child in expressing himself, or to define reality for him. Children in turn respond less to what is said to them than to action, gestures and the affective tone of the communication. In general, the community seems to prefer action solutions to problems, rather than discussion, talking things over, thinking, etc. Letters and numbers have little "intrinsic" interest for the children and need to be associated with rhythmic, affectively arousing games (e.g., gambling games) before the child will attend and learn. Verbal scores on the Wechsler tend to be lower than performance scores in older children. There are few books in these homes, and children are rarely read to. On the other hand, when children were given books, through the Harvard Phillips Brooks House program, as their own possessions they first treated them as valuable and attractive possessions, to be hoarded, but did read them.

(4) The life histories of both the children and adults are filled with "traumatic" events and chronically traumatic milieu factors which require constant expenditures of energy to manage. What energy is left over for discussion of family affairs, or attention to a child by teaching, playing or conversing with him is often minimal.

(Brodie)

(5) There is considerable lack of interest of the child's growing intelligence or emotional maturity, and some suggestion that the various stages into which we divide childhood, are not differentiated so that standards of expectable behavior are less flexible. A school-age child is treated more like a grown-up in the independence and know-how he is expected to have and the sorts of situations to which he will be exposed. Children's behavior is rarely understood in terms of fear or shame or guilt or dependency, but rather as "good or bad."

In summary, we think that the learning of the young child in a culturally deprived environment is hampered by:

(1) Growing up in an environment where crises are continuous and where the preferred mode of dealing with them is immediate action. Talking about, thinking, planning, and postponement of a solution are relatively rare.

(2) Learning from adults who have little energy to devote to teaching, playing, talking to or reading to him in a relatively relaxed or sustained way, and with "teachers" who are relatively insensitive to stages of development of his language and thought.

(Brodie)

More specific hypotheses will be developed with further contact in the South End, and stated in a testable form.

RESEARCH PLANS FOR STUDIES OF COGNITIVE SOCIALIZATION

Alfred L. Baldwin
Clara P. Baldwin
New York University

The purpose of these studies is to investigate cognitive socialization in children by means of observational studies in naturalistic situations supplemented by experimental studies in controlled situations. For the purpose of this study, cognitive socialization will be taken to refer to the processes by which the child's experiences with other people, as well as with materials, facilitates his cognitive development. Cognition will be used to refer to those processes which relate to obtaining, processing and utilizing information. It includes the processes of gaining information, those which organize this information into structured cognitive systems, the skills and habits for extracting information from situations and finally the procedures for utilizing information for the satisfaction of needs.

We begin with certain assumptions about the components of cognitive development. There are a number of necessary components in cognitive development, some of which form sequences in which each member is necessary for the appearance of later developments. Some of these components are not explicitly cognitive, e.g., dependency needs, impulse control, and need achievement. Others describe the process of information processing, e.g., attention and its deployment, language acquisition, and the acquisition of structured information.

The strategy of these investigations is to begin with the observation of the various interpersonal interactions in which the child is involved in a naturalistic situation -- to begin with we will concentrate on the verbal interactions of preschool teachers and children, as well as parents and children. The investigation of cognitive development in these situations involves a number of problems: 1) Sampling; 2) Coding observations; 3) Discovering the immediate reactions to the child's and the adult's behavior that may function as reinforcements or inhibitors from the point of view of the child and which represent the response of the child to the adult behavior; 4) Finding methods of analysis that describe the total adaptation of the child to the total environment in which he lives in order to think intelligently about the effect of an educational program, an institutional regime, or an entire home. Each of these will be discussed in turn.

1) Sampling. Since not all the behavior in an environment can be observed, it is important to sample it in a representative fashion that is also efficient. We have already carried out several studies to determine the various settings within the nursery school environment,

(Baldwin)

and their importance as part of the environment in terms of the time children spend in each of them. It is clear, for example, that such settings as outdoor play, indoor play, organized group activities and routines each elicit a quite different pattern of behavior from the teacher. At the same time behavior in some of these situations (e.g., story groups) is more standardized than in others so that they need not be sampled as heavily to obtain a picture of teacher-child interaction. It is also clear that for the comparison of different schools, there are differences not only in the way the teachers behave in particular settings, but also in the relative time spent in the various settings. Our procedure is to map out the school by very rapid observation of the gross types of behavior and the setting before proceeding to a more careful recording of verbal interactions. A preliminary sampling of this kind permits the later observations to be planned more efficiently.

2) Coding and categories. Our immediate task is to devise a sensitive set of categories for describing cognitively relevant behavior. There are already quite useful category systems for describing interpersonal behavior in terms of motives and social impact (aggressive, dependent etc.) and we will use those categories for that purpose. But we need categories that deal with information

exchange and processes (e.g., statement of fact, asking questions, answering questions completely, reflecting question back to questioner, correction of error, explanation of reasons, etc.). Thus far we have studied these interactions in global terms to spot the amount of interaction that is roughly concerned with information as opposed to other uses of verbal behavior such as giving emotional support, demanding compliance, etc.

3) While there is much to be said for outcome measures in the evaluation of educational programs, the detailed observation of the interaction process is also an essential part of the evaluation process. One of its advantages is that it probably contains the cues which actually guide the behavior of the participants. The simplest way of looking at the consequences of behavior is to ask whether in the natural habitat it is reinforced or rewarded. The trouble is to identify reinforcements that occur in the natural habitat. Does an answer reinforce a question, in the sense of encouraging question-asking? Do responses that call for a response provide more reinforcement for conversation than a response that ends the conversation? And then, there are overt approval reactions as well as merely attending that must also reinforce interactions. These questions can be explored

in observational studies, but they also require experimentally controlled interactions between an experimenter and a subject.

4) Finally the problem of assessing the total fit of a child to his environment must be faced. For this the concept of adaptation and adaptive fit seems appropriate. The problem is to decide what are the behavioral symptoms of adaptive fit and how to recognize them. The following three ideas represent our beginning notions about how adaptive fit might be assessed empirically. 1. If the behavioral repertoire of the individual and the relative frequency of the various elements of the repertoire remain constant, then in some sense there is an adaptive fit or equilibrium condition. Such a fit might be highly rewarding or not, although presumably the rewardingness of the interaction is one factor that maintains behavior or changes it. 2. This suggests that the total rewardingness of an environment to a child should be measured -- a first index might well be the percentage of actions that are reinforced.
3. There is another kind of equilibrium, stemming from Piaget's discussions that emphasized operational structures containing reversible actions. There is a sense in which the child's equilibrium might be described in terms of the degree to which he gets himself into situations that

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turn out to be frustrating and from which he cannot rescue himself. The notion of reversibility suggests that the child can get himself out of whatever situations he gets himself into. He may be put into frustrations by others; he can't help that. But if his schema form a reversible system, he should not get himself into such predicaments.

This is the current status of our study of the role of preschool inter-personal interactions in cognitive socialization. In addition to this study, we have the opportunity to participate in the design of an institution for infants that will provide an optimal institutional environment. This project will allow the preliminary exploratory study of certain aspects of infant development and their modification. The basic hypothesis that will be investigated is that there is real advantage in providing special training to children in simple "tool" skills at a time when they are young enough to find such elementary skills challenging. Thus, for example, phonics is introduced in some Russian preschools on the grounds that preschool children find the pronunciation of nonsense syllables interesting at that age, whereas at age seven or eight, the semantic meaning of words is more important and phonics is dull and uninteresting. Thus if we combine this idea with Piaget's hypotheses about the stages of infant development, we might want to provide training in

(Baldwin)

some elementary schemas at stage 3 to build up an adequate basic repertoire of schemas, the basic vocabulary so to speak. Then at stage 4, the emphasis might be on the organization of these schemas into linear means-end sequences, while at stage five, the child should be given plenty of freedom to spontaneously vary these schemas to build a broader structured system of schemas. Theoretically, the interesting notion is a different conception of the "right time" for training. If the hypothesis should be confirmed, then from a practical viewpoint the problem would be to decide what is a minimum essential repertoire of schemas for children in our society.

Perceptual Discrimination, Social Class, and Age: A Brief Description of Planned Research

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New York Medical College

The research planned represents a continuation of a line of work which has been pursued over the past five years at the Institute for Developmental Studies. It involves the investigation of the potential mediators between environmental conditions-- particularly adverse environmental conditions--and school performance, with measurement of the cognitive functions which underlie and relate to that performance. Environmental conditions can be roughly categorized by the shorthand which is known as socio-economic status, or SES designation. We have worked out the Institute SES Index, which has been used successfully in a series of studies. It is proposed that it be used in the present study in order to categorize the social class status of the subjects.

We have reported elsewhere a relationship between poor auditory discrimination ability and reading. In addition, it has long been shown that there is a higher incidence of reading retardation among culturally disadvantaged populations. It has been postulated that one possible specific effect of a disadvantaged environment is a poorer preparation for making fine auditory discriminations, and that this might be an avenue by which

(Deutsch)

environmental conditions influence reading disability.

We have investigated several parameters of this problem but we have not as yet looked systematically at the relationship between social class membership and auditory discrimination ability. As part of such a systematic investigation we propose to evaluate developmental patterns in auditory discrimination; to compare auditory, visual, and tactual discrimination ability; to evaluate the relationship of aspects of language functioning to reading; and to study the influence of auditory discrimination and social class membership on language functioning.

The subjects of the proposed studies will be lower class and middle class normal and retarded readers selected from first, third, and fifth-grade classes in the New York City public schools. (The selection of first-grade subjects will be based on scores on the Institute's Reading Prognosis Test).

The techniques to be used will be those which have been developed at the Institute and which have been previously used successfully with similar samples. These include a rather extensive auditory discrimination battery which makes use of meaningful and non-meaningful sounds, of words, and of several varieties of responses on the part of the subjects. This battery is currently

(Deutsch)

undergoing item analysis, and, by the time the proposed research is initiated, should be pared down from its present eleven tests to four or five of the most discriminating ones. A tri-modal discrimination battery (using one modality at a time) which is currently undergoing item analysis will also be pared down for the proposed research. To be developed, will be two or three intermodal tasks. In the language area, the Illinois Test of Psycho -Linguistic Abilities (depending on our current experience with this test) and one or two of the cloze tests previously developed for use with children of the populations from which the current samples are to be drawn, will probably be used. Social class membership will be assessed by means of the Institute's Socio-Economic Status Index. Subsidiary measures will include the Lorge-Thorndike Intelligence Test, and the Benton Right-Left Discrimination Test and the Harris Tests of Lateral Dominance. In an effort to define the attentional factors which operate in perceptual discrimination measures, it is planned to use our modified version of the Continuous Performance Test. Results will be analyzed along the major independent variables of age, reading ability, and socio-economic status, and an extensive correlational and factor analysis will be carried out to define patterns of relationship.

3

(Deutsch)

While the techniques suggested make a rather formidable list, it is anticipated that by judicious selection on the basis of previous experience and a few small pilot runs, the total individual testing time for each child can be reduced to about three sessions.

In addition to providing information about relationships among social class, discrimination functions, and reading, the study should yield data relevant to the continuing discussion of the relative roles of verbal and perceptual mediators in learning and problem solving.

Expansion Training and the Child's Acquisition of Grammar

Courtney B. Cazden
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Harvard University

An important part of the study of first-language acquisition is the isolation of aspects of the child's environment which affect language development. In this research two influences on the acquisition of grammar will be studied: adult expansion of the child's speech and simple exposure to well-formed sentences.

This research is part of Roger Brown's long-range study of how children learn to speak. His protocols consist of spontaneous interaction of parents and their 18-36 month-old children. One feature of the parent's role is what Dr. Brown, calls "expanding" : to the child's telegraphic utterance the parent often responds with the nearest complete sentence appropriate in the particular situation (Brown and Bellugi, 1964). One is tempted to assert that a powerful aspect of the child's environment has been identified. It can be argued, however, that what is important is not a particular kind of interaction but simply ample exposure to well-formed speech, that the critical role of the adult is not expanding but modeling. When evidence is limited to natural observations it is not possible to separate these two features of the child's environment. This research is planned to obtain that separation.

The sample will consist of 12 lower-class children from 30-36 months old in a day-care center for working mothers. Lower-class children will be used because presumably they are not already receiving an ample exposure to speech or a maximum of expansion training. 30-36 months is the age when the sentence is beginning to be developed and when expansions should be most effective. A small sample will make it possible to go beyond statistical comparisons to a closer look at the process of grammar acquisition.

The children will be randomly assigned to three groups, two treatment and one control. One treatment will consist of expanding as many utterances as possible; the other treatment will consist of reading and talking to the child but not expanding any of his utterances. These treatments will be given individually for about 45 minutes each school day for sixteen weeks. The control group will get no verbal enrichment but will have equal opportunity for individual attention.

Measures of language development will be taken at the beginning, middle and end of the treatment period. These will include indices from samples of spontaneous speech and scores obtained from structured situations.

(Cazden)

Possible tests are the one devised by Fraser, Bellugi and Brown (1963) for studying the control of grammar in imitation, comprehension and production, and Jean Berko's (1958) test for the productive use of inflections. Speech samples will be taped and the tapes transcribed by someone ignorant of the treatment assignment of the children.

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Mental Abilities of Children in Different Social Class and Cultural Groups

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Harvard University

The purpose of this study is to examine the patterns among various mental abilities in young children from different social class and cultural backgrounds. Our main intent is to extend the empirical analyses of the development of differential mental abilities in children, but the findings of this research also bear directly upon the problems of building valid and precise assessment instruments for children from different cultural groups. The hypotheses tested are (1) that significant differences exist among groups of children from different social class and cultural groups in each of four mental ability areas (verbal ability, reasoning, number ability, and space conceptualization) as well as in the patterns or configuration of scores in these diverse areas of mental ability, and (2) that social class and cultural group influences interact in determining the level of each mental ability and the nature of the patterns among them.

Earlier Research

Our earlier research on this topic began in response to a series of local problems -- problems which were plaguing a particular nursery and elementary school for gifted children which is run by Hunter College for children drawn from the Borough of Manhattan. These problems were as follows:

1. Restriction in the sampling of abilities yielded by the standardized intelligence tests which had been used as admissions criteria.
2. Restriction in range of cultural groups present in the school.
3. Parental coaching.
4. Differences among psychological testers.

In order to cope with these problems, our earlier project attempted to identify and measure various forms of outstanding ability in very young children, to develop special instructional programs relevant to each mental skill, and to examine the classroom response to special instruction of children selected as exceptional in these different areas of mental ability. As a product of this earlier research, reliable scales were developed for measuring these various mental abilities in young children.

Current Research

We have been using revised versions of these earlier tests to study the effects of several social class and cultural influences upon the development of mental abilities in young children. What patterns of intellectual strengths and weaknesses are produced by different cultural backgrounds and what school programs are best suited to children with these patterns of abilities? To begin to answer these questions, we have studied 320 first-grade children from the following eight social class and cultural groups in New York City and its environs: middle and lower-class Negroes, middle and lower-class Puerto Rican children, middle and lower-class Jewish, and middle and lower-class Chinese children.

Our design is a 4 x 2 x 2 analysis of variance with covariance control. We include children of four ethnic groups (Chinese, Jewish, Negro, and Puerto Rican), each divided into two social class groups (middle and lower), each, in turn, divided into equal numbers of boys and girls. Thus, we have a total of 16 sub-groups (one being, for example, lower-class Chinese girls), each composed of 20 children. Our full sample is made up of 320 children age 6 years 2 months to 7 years 5 months drawn from the first grades of 45 different schools in New York City and its environs. We use three variables as co-variates: a measure of effort, a measure of responsiveness to the tester, and age.

Several major obstacles have been encountered in conducting this research.

1. Perhaps the foremost problem was that of getting

school authorities to cooperate in or even permit a research effort on such a presumably controversial topic. Lengthy negotiations were conducted and several restrictive conditions were accepted in order to gain permission to perform this study.

2. An associated problem was that of getting the data necessary to locate concentrations of people within each social class and cultural group category. There are strong legal restrictions upon collecting such data -- and these restrictions are perhaps quite justified -- but since it is not permitted to ask parents directly about education or religion or occupation, we were forced to use information gathered indirectly through 23 different agencies.

3. Perhaps the major technical problem in this research was to insure the fact that observed differences among social class and cultural groups reside in the children and not in the test materials themselves. To accomplish this, tests were constructed which presupposed only experiences which were common and familiar within all the different social class and cultural groups within an urban area. We had no intention to "free" the test materials from cultural influence, but rather, the tests utilized elements that appear commonly in all social groups

in New York City. If, for example, in our earlier research we had used pictures of xylophones or giraffes (which a middle-class child is more likely than a lower-class child to encounter in a picture book or in a zoo), these were replaced by pictures of busses, fire hydrants, lamp-posts, garbage trucks, and police cars -- objects to which all urban children are exposed.

4. Another technical problem was associated with the fact that each child was tested by an examiner representing the child's own cultural group in order to maximize chances of establishing good rapport and to permit the administration of the tests in the child's primary language, or in English, or, more often, in the most effective combination of languages for the particular child. Thus, we had a Negro tester, a Spanish-speaking Puerto Rican tester, a Yiddish-speaking Jewish tester, and three Chinese-speaking Chinese testers to accomodate the eight different Chinese dialects encountered among the Chinese children tested. The technical problem emerged when the testers empathized so strongly with the children from their own cultural groups that it was very difficult to get them to administer the tests in a fully neutral and uniform manner. We were forced to great lengths to remove this source of bias from the test results.

A few illustrative results from this study will illustrate our data analyses:

1. A distinct "convergence" effect has emerged within the middle-class groups. For the middle-class children, the mental abilities of the different cultural groups resemble each other to a much greater extent than for the lower-class children. That is, the middle-class Chinese, Jewish, Negro, and Puerto Rican children are much more alike in their mental ability scores than are the lower class Chinese, Jewish, Negro and Puerto Rican children. Formal schooling could not have produced this convergence among middle-class children -- all children were first graders and little formal schooling had taken place. This convergence effect is reflected in the significant ethnicity x social class interactions presented in the analyses of variance.

2. Another finding is that social class position seems to make more of a difference to the Negro children than for the others. The middle-class Negro children are more different in mental abilities from the lower-class Negro children than, for example, the middle-class Chinese are from the lower-class Chinese.

3. The analyses of variance with covariance control describe the effects of social class and ethnic group

conditions upon each mental ability variable singly. Our hypotheses also consider the manner in which different cultural conditions affect the development of patterns or configurations among all mental ability scores considered in combination. Both ethnicity and social class affect the level of mental ability considered singly. Ethnicity continues to affect the patterns among the mental abilities very strongly. However, social class differences in the patterns of mental ability were negligible. That ethnicity holds up so strongly and social class effects disappear when patterns of mental ability are considered is a surprising finding in view of the numerous results in the literature indicating the enormous power of social class influences upon development.

4. A discriminant analysis of these data indicates how well each of the children in a particular group (e.g. middle-class Chinese boys) fit the pattern of mental abilities for that group. For example, most of the lower-class Chinese girls look like lower-class Chinese girls in their mental ability patterns. A few exceptions, however, resemble middle-class Jewish boys in the patterns of ability. We are now examining the individual cases in detail.

5. Lastly, we have made some analyses within groups as well as between groups. For example, we have looked more closely at the lower class Negro group to see what variables -- such as father presence or absence, recency of migration to the North, number of siblings in the family, the work status of the mother, and so forth -- affect their behavior on our measures.

The Use of Linguistic Structures in Learning

William D. Rohwer, Jr. and Robert E. Davidson
University of California, Berkeley

We start with the view that important individual and group differences in verbal learning efficiency are due to differential facility in the use of linguistic structures as a means for achieving mastery. A recent series of experiments (Davidson, 1964a, 1964b; Jensen and Rohwer, 1963a, 1963b, 1964; Rohwer, 1964) provides clear evidential support for this view. The method used in the initial experiments of this series was quite simple but, nevertheless, produced marked improvement in the rate of paired-associate learning for certain kinds of subjects. Typically, a control subject was asked to learn an eight-item list of paired pictures by an anticipation method. The first, or study, trial for such a subject consisted simply of the presentation of each pair by the experimenter and the naming of each picture by the subject. An experimental subject, whose task was to learn the same list of paired pictures, did more than name the pictures during the study trial; he repeated a sentence for each pair, a sentence containing the names of the two pictures (e.g. The COW chases the BALL). Thereafter, the procedure was identical for both conditions; the list was repeatedly presented until the criterion of one perfect recitation was attained.

(Rohwer)

The results of these experiments were unequivocal: for mentally retarded adults and for second, fourth, sixth, and tenth grade children of superior intelligence, the experimental condition produced learning that was from two to eleven times more efficient than that produced by the control condition.

The remainder of the present series of experiments marks the beginning of our attempt to specify the conditions necessary for the sentential facilitation of paired-associate learning and to specify the properties of sentences that control the magnitude of the effect. We have used the sentence method in three ways: In one case, the experimenter supplies the sentences and the subject repeats them; in the second case, the subject generates the sentences himself; and, in the third case, the experimenter utters the sentences and the subject simply listens. The operational distinctions among these forms of the sentence method suggest that a conceptual distinction be made between a child's ability to use sentences in the service of learning and his ability to generate sentences for that purpose. When we asked children to generate their own sentences (Jensen and Rohwer, 1964), we found that kindergarten children did not benefit by the self-formulated verbal strings. In an incidental way, we noticed that these young children typically generated two noun phrases linked together by a conjunction (e.g. the COW and the BALL) rather than by a verb as they had been instructed to do. Correlatively, we found (Rohwer, 1964) that providing sixth grade children with conjunctive phrases produced no relative facilitation of learning in contrast to the marked facilitation produced when sentences were provided. In a related experiment, Davidson (1964a) found that, for both fast and slow learners, prepositional phrases and sentences produced substantial facilitation but conjunctive phrases did not. Additional corroboration on this point comes from another experiment in which Davidson (1964b) provided either kernel sentences, passive transformations of the kernel sentences or conjunctive phrases. The kernel sentences produced the most facilitation, the passive sentences a middling amount, and the conjunctive phrases produced the least.

These results have led us to plan a systematic program of research with the intent of arriving at a description of the process of linguistic facilitation, further specifying the conditions that control the degree of facilitation, and determining the manner in which age and social class membership relate to the abilities of generating and using linguistic structures in learning. With regard to process questions, we plan to explore, for example, the relative efficacy of pictorial and verbal structure in the facilitation of learning, and to determine the portions of the verbal string that are actually stored by a subject in learning the constituent paired associates. In an attempt to extend our analysis of the conditions of facilitation, we intend to manipulate variables related to sentence type and complexity, inter-sentence similarity, and the classes of words to be recalled. With regard to subject variables, we plan to study separately the abilities to generate and to use linguistic structure in learning as they develop in children drawn from various socio-economic categories. Finally, we hope to obtain normative data on individual differences in the relative predictive potency of various parts of speech by means of a modified cloze procedure in which words are deleted systematically with respect to the parts of speech of the preceding word or words.

AURAL AND VISUAL LEARNING IN CHILDREN

Milt Budoff
Tufts University

The projected program of research has the following purposes:

A. To study the relative efficiency of learning via aural and visual modality presentation in samples of children ranging in age from 5 - 13 years;

B. to compare this process of learning among children from various socio-economic backgrounds;

C. and among samples of poor, average, and good readers from each of these socio-economic backgrounds.

Little is known about the relative contribution of aural and visual processes to young children's learning. Studies which have sampled learning behavior in children from unspecified backgrounds at a few age levels suggest that meaningful materials are learned most rapidly via aural modality presentations among primary grade children (Young, 1936; Russell, 1928; Budoff, and Quinlan, 1964a). Meaningless material, which is more difficult, e.g., nonsense syllables, are learned more rapidly visually (Otto, 1961). With increasing age, visually presented materials are learned more rapidly (Goldstein, 1940). But, there is a suggestion that with older grade school children (4-7 grades) learning rate via the two modalities varies with ability level and reading status. Brighter children learn more rapidly with visually presented materials; children of average or dull ability perform more efficiently with aurally presented stimuli. Poor readers, of average ability and children of retarded mental ability, even at the high school levels, learn more rapidly with aurally presented materials (e.g., Goldstein, 1940). It may be that these generalizations may even apply at the younger ages. No data is available that has controlled ability levels throughout the age range. One objective of the proposed program of research is to clarify in a systematic study the relation to learning efficiency of these two sensory modality inputs over the age range from 5 - 13 years.

Further, there is conflicting data with samples from various socio-economic backgrounds. Research with lower middle and working class second grade children using a paired associate paradigm and employing meaningful words as stimuli found a more rapid rate of learning on the aurally presented materials (Budoff & Quinlan, 1964a). Katz and Deutsch (1963) have reported that slightly older Negro children from Harlem learned meaningful words more rapidly when they were presented visually, using a serial learning paradigm. They failed to include comparison groups of middle class children in their study, making it difficult to distinguish the differences that may be due

Table 1. Description of Experimental Design for a Single Age Group

6 year olds			
Middle Class	Negro (30)	High IQ	Good Reader/s
			Average Reader/s
			Poor Reader/s
		Low IQ	Good Reader/s
			Average Reader/s
			Poor Reader/s
	White (30)	High IQ	Good Reader/s
			Average Reader/s
			Poor Reader/s
		Low IQ	Good Reader/s
			Average Reader/s
			Poor Reader/s
Working Class	Negro (30)	High IQ	Good Reader/s
			Average Reader/s
			Poor Reader/s
		Low IQ	Good Reader/s
			Average Reader/s
			Poor Reader/s
	White (30)	High IQ	Good Reader/s
			Average Reader/s
			Poor Reader/s
		Low IQ	Good Reader/s
			Average Reader/s
			Poor Reader/s
Lower Class	Negro (30)	High IQ	Good Reader/s
			Average Reader/s
			Poor Reader/s
		Low IQ	Good Reader/s
			Average Reader/s
			Poor Reader/s
	White (30)	High IQ	Good Reader/s
			Average Reader/s
			Poor Reader/s
		Low IQ	Good Reader/s
			Average Reader/s
			Poor Reader/s

to task from the differences in sample populations.

A recent study by Budoff and Quinlan (1964b) compared the rates of learning, aurally and visually, among average and poor readers in the second grade. While both groups learned the meaningful words more rapidly on the aural presentation, there were some tentative findings which suggested that the poor readers tended to learn more rapidly aurally than the average readers and more slowly visually than this latter comparison group.

The outlines of the projected study then are as follows. Children, from 5-13 years of age, will be selected and grouped by socio-economic background, and reading status, two levels of IQ, (average ability, 85 or 90 - 110 IQ), and bright-normal and superior ability, (111 - 130 IQ) and race (Negro and white). All the subjects will be boys. The experimental design details the sub-samples for one age group only, but is the model for all the age groups to be studied. (See Table 1). All age group comparisons will be made separately and also in the combined analysis of variance design with age levels as an additional between-groups variable.

Tasks:

Two learning tasks will be formulated using a paired associate paradigm, a meaningful task consisting of word pairs and a meaningless task in which colors will be paired with nonsense syllables. The latter will be assumed to be more difficult. Literature is available to substantiate this assumption. The length of the list will be varied, depending on the age level, to allow for increasing difficulty in both tasks. Both aural and visual portions of a given learning task will be administered to the child, at the same time. The learning task, should be completed within one-half hour. The tasks for each age grade will have to be pre-tested to ascertain difficulty level. At the seven and eight year old levels, two meaningful tasks will be used, a word and a picture task on both the visual and aural presentations. The tasks will be administered late in the school year to assure maximal comprehension of the words included on the task. Only the picture task will be used with the five and six year olds. The aural tasks will be presented via a tape recorded administration. Visual materials will be presented either by memory drum or Hunter card master to control for the mechanics of presentation.

Pictures task:

Pictures of common objects will be photographed and paired in a random manner to constitute the visual task. Names of objects will be paired randomly and presented on a tape recorder.

(Budoff)

Words task:

Words, controlled for length and syllabification will be selected from the reading vocabulary of each school grade and presented visually. Words from a similar pool which have been pre-tested to assure comparability of difficulty will be paired randomly and presented aurally via a tape recorder.

Task 3- Colors will be paired with low association value nonsense syllables to constitute the difficult learning task and will be presented aurally and visually.

Supplementary measures:

A number of supplementary measures will also be administered and correlated with learning sample performance because they relate to the aural-visual problem, e.g.,an auditory discrimination task and John Carroll's aural learning task.

MB/al

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BRIEF STATEMENT OF RESEARCH IDEAS:
MOTIVATIONAL CONTENT ANALYSIS OF PRIMERS

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Our interest has been in the reading primers used in first grade. Although we assume that the rate of increase in vocabulary used in these books is appropriate to the learning potential of first graders, we have felt that the content of the books, the choice of words and the themes of the stories are of low motivational value. We have been struck by the fact that the stories contained in these books, although most of them depict family life, actually have little resemblance to the every day life of six year old children. They are unimaginative, are restricted to middle class situations, and are overly pollyannish. Many children, because of individual, family, and/or cultural values, are motivated to learn to read before they are introduced to these primers, and for these children the nature of the material may well be an insignificant variable in their learning to read. But for many other children who go to the first grade with no strong internal desire to read, the role of content as a motivational factor may be of considerable significance.

In essence, then, our research stems from a dissatisfaction with the nature of the reading materials used in the schools today. Others have expressed the similar dissatisfactions. Sylvia Ashton Warner in her book "Teacher" points out that she was able to achieve significantly better results in teaching children to read if she used stories which had relevance to the kinds of situations and questions encountered in their lives by her pupils, and bemoaned the usual "Janet and John" readers. We have been unable to find in the literature research projects devoted to assessing the significance of the content of readers, although more than one project has been carried out which indicates that the kinds of stories used in primers, that is, family stories, tend not to be selected by children when given free choice in libraries.

HYPOTHESES:

After reading a number of these primers, we selected three important dimensions along which the content of the stories could be rated. These three were (1) the age at which children engaged in the activities depicted in the stories, (2) the sex of children most likely to engage in these activities, (3) the relative success with which the activities depicted in the story were completed. Our hypotheses were that:

1. More often than not, the activities depicted in

the stories are, in life, engaged in by children of less than six years.

2. The activities depicted in the stories are most frequently those which in our culture are carried out by girls.
3. The masculine activities depicted in the stories end in failure more often than do the feminine activities.

Since our project began we have also become concerned with the interest values of these stories. Our general hypothesis here is that first grade children will find stories having to do with adventure, fantasy, exploration, normal conflicts and real emotions to be more interesting than the stories used in present day primers.

PROCEDURES:

We first attempted to ascertain whether or not our hypotheses about the content of these stories would be corroborated by our own ratings of a random sample of stories taken from two publishers series. We obtained enough support to merit going ahead and asking other adults, both professional and lay people, to rate the stories. The results here were less encouraging, primarily because of our failure to clearly communicate and define the nature of the dimensions we wished to have rated. However they were still supportive.

(Blom)

Despite our inability to obtain clear cut evidence for our hypotheses at this point, we decided to go ahead in two directions. First, we wondered what the children themselves thought of the stories, and attempted to solve the many methodological problems inherent in obtaining meaningful responses about the stories from first graders. We have developed pictorial scales that the children can check to express what they think about the stories in terms of our dimensions. That is, the scales include one which depicts children of various ages and we ask the children to mark the picture which represents the age at which children most often engage in the activity depicted in the story. Similar scales represent the sex and activity outcome dimensions. In addition we have developed a similar scale on which the children can rate the story in terms of its interest value. At this time we are carrying out pilot studies to assess the effectiveness of the scales.

The second direction we have chosen is to rate every story in a large population of stories along a number of dimensions, including those most directly relevant to our hypotheses. We chose the twelve publishers series which are most frequently used in the school systems across the nation. The ratings of our two raters are based on a manual which outlines the criteria to be used. The manual

(Blom)

lists a large number of children's activities according to the age at which children are most likely to engage in them and the sex of children who prefer each activity. The assignment of the activities in the manual to the sex and age categories was devised by the four professional members of our research group using our experiences as teachers, therapists, diagnosticians and parents, together with observations by other parents and professional people. We found that the raters could use these manuals quite effectively, obtaining percentages of agreement of around 90. Based on the ratings of this population of stories, (a population which will exceed 1,000) we will be able to selectively or representatively sample these stories for use in future studies. For example, we will be able to determine which kinds of stories appeal most to the children, and which kinds have little interest value.

SUMMARY AND IDEAS FOR THE FUTURE:

In summary, we have found the study of the content of children's primers to be a fascinating one. This research area is one which demands inventiveness in devising new methods. We may have considerable difficulty in obtaining responses from children in terms of the dimensions cited in our hypotheses. However, we are confident that we can devise ways of getting children to indicate their preference for different kinds of stories. Therefore, in the future

(Blom)

we may work more toward developing different kinds of interest scales, and divising new methods of obtaining data. In addition, we hope to carry out several cross-cultural studies.

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WHAT IS PROJECT LITERACY?

Project Literacy was organized at Cornell University on February 1, 1964, by a developmental projects award from the Cooperative Research Branch of the United States Office of Education. This project represents one of the major commitments of the Office of Education to basic research and curriculum development concerning both child and adult literacy.

The purpose of Project Literacy is to organize, in various universities, laboratories and state departments of education, research which is essential to understand the acquisition of reading skills. The major initial effort is to bring together researchers and educators from a variety of disciplines to plan research which, when taken as a whole, will give us more substantial results than any single study can provide. Each investigator in the research consortium will be completely responsible for his own activities. The project will provide mechanisms whereby the individual scientists can communicate their research strategies, problems and results to each other and when necessary they will be able to meet together. The research findings will be brought to bear on curriculum developments. When called upon, Project Literacy can provide technical research consultation. The group at Cornell University will also undertake a program of studies similar to those which will be initiated in other settings.

We believe that much current and potential research in learning psychology, visual perception, cognitive behavior, neurophysiology of vision, child development, descriptive linguistics, psycholinguistics, the sociology of educational innovation, research with culturally disadvantaged children and programmed instruction (to cite some examples) are essential to understanding literacy. Consequently, we are endeavoring to locate research interests which heretofore may not have been considered relevant to this crucial educational research area.

REPORT OF THE

FOURTH RESEARCH PLANNING CONFERENCE

"CURRICULUM DEVELOPMENT AND TECHNIQUES OF INSTRUCTION IN READING"

Held Under the Auspices of

Project Literacy

in

Princeton, New Jersey

December, 1964

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RESPONSIVE ENVIRONMENTS

Omar Khayyam Moore
Rutgers University

The Responsive Environments Project, which is the topic under discussion here, is an interdisciplinary effort involving the close cooperation of specialists representing four distinct areas of competence: the behavioral sciences, education, engineering, and the formal sciences.

The goal of the Project:

(A) from the standpoint of its behavioral scientists, is to formulate and test a broad theory of human higher-order problem solving and social interaction. A number of papers are now available (or forthcoming) which report the progress made thus far in this direction (1)(2)(3)(4)(5)(6)(7)(8)(9).

(B) from the standpoint of its educators, is to test new learning environments in the context of public and private schools, and institutions devoted to exceptional children. Thus far, programs have been run in seven places:

(1) Boston University, Department of Special Education, Dr. Burton Blatt.

(2) Freeport, Long Island public schools, Dr. John Martin, now superintendent of the Mount Vernon, New York, public schools.

(3) Hamden Hall Country Day School (private), Edward I. McDowell, Jr., now president of the Responsive Environments Foundation, Inc., 20 Augur Street, Hamden, Conn.

(4) Mary Imogene Bassett Hospital in Cooperstown, New York, Mary and Campbell Goodwin, M.D.s in pediatrics.

(5) New York City's Harlem's P.S. 175, Dr. Edward G. Bernard, President, The Council of Directors, Board of Education of the City of New York.

(6) The Responsive Environments Foundation, Inc., Joseph R. Dunn, Jr., Administrative Director of Research, 20 Augur Street, Hamden, Conn.

(7) Trenton, New Jersey Settlement House, Dr. David Rosenhaun of the Educational Testing Service, Princeton, New Jersey.

Studies conducted at each of the locations mentioned above differ in terms of focus of interest, design of research, and duration of project. These investigations taken collectively range over children from the top to the bottom of the social class system, from the physically sound to the physically handicapped, from the gifted to the educable retardate, from the school drop-outs to two-year olds. Reports are now available pertaining to work at the various locations. At the moment a complete bibliography is not available and the best procedure is to write to the person in charge.

(C) from the standpoint of its engineers, is to design, test and make production models of semiautomated and automated learning devices which satisfy the following criteria:

(1) they permit the learner to explore freely.

(2) they inform the learner immediately about the consequences of his actions.

(3) they are self-pacing, i.e., events happen within the environment at a rate determined by the learner.

(4) they permit the learner to make full use of his capacity for discovering relations of various kinds.

(5) their structure is such that the learner is likely to make a series of interconnected discoveries about the physical, cultural or social world.

The first major product of the engineering team is E.R.E., the Edison Responsive Environment--the talking typewriter. A patent has been issued for this invention and other patents are pending (10)(11).

Inquiries about E.R.E. should be directed to Norman Kriesman, The Responsive Environments Corporation, 21 East 40th Street, New York City. (None of the educators, behavioral scientists or formal scientists connected with this project have any commercial interest in the sale or distribution of the E.R.E. instrument.)

(d) from the standpoint of the formal scientists, is to develop new branches of formal logic that are mathematically interesting in their own right and that are likely to be of help to behavioral scientists in clarifying problems and constructing theories. Research in two branches of mathematical logic have been stimulated by the Project's work--deontic logic and the logic of entailment (12)(13)(14).

Inquiries about these developments should be directed to Professor Alan Ross Anderson (formerly of Yale; as of September 1, 1965, The University of Pittsburgh, Department of Philosophy, Pittsburgh, Pa.).

Up to the present time, most of the empirical research has been carried out with children ages 2 through 8. The basic intellectual skills that the children have acquired are reading, writing, taking dictation, and publishing newspapers. However, there are no theoretical reasons why other content areas, e.g., mathematics, foreign languages, cannot be handled in similar ways. Plans and some pilot studies have been made for widening the scope of the program to cover these other content areas.

The financial support for the research has come from many sources but the principal donors have been the Carnegie Corporation of New York, and the Office of Naval Research, Group Psychology Branch. The cost of research and development in engineering has been borne by the Thomas A. Edison Laboratory at West Orange, New Jersey, a division of the McGraw-Edison Company. Inquiries pertaining to engineering should be directed to Mr. Richard Kobler, Manager.

I serve as the general director of the Project. (Presently, Rutgers University, Department of Psychology, New Brunswick, New Jersey. As of July 1, 1965, University of Pittsburgh, Department of Social Psychology, Pittsburgh, Pa.)

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AN ABSTRACT OF PROPOSED RESEARCH DIRECTED TOWARD DEVELOPING SELF-INSTRUCTIONAL READING PROGRAMS

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Objectives

The major objective of the proposed research is to develop a set of self-instructional reading programs that will teach essentially all individuals who meet specified program entry requirements. General increase in the average reading skill of a group is not the objective, rather, uniformly high standards of performance are sought in each and every individual.

Programs will start at the pre-reading level and attempt to take individuals to the point of "independent" reading. "Independent readers" are defined as individuals who have attained a level of skill and interest in reading which can be maintained and increased from that point on by the contingencies of the usual school and community environment.

In order to maximize the usefulness of the programs with diverse populations such as adult illiterates, children from backgrounds far different from those used in the developmental activities, and non-native English speakers, certain special features will be incorporated: a) Entry requirements -- insofar as possible, entry requirements will be minimal and will consist only of those behaviors likely to be in the repertoires of individuals from a wide range of cultures and of diverse abilities. b) Flexible entry -- assessment procedures will be developed that will make it possible to place individuals into the programs despite having started instruction under different systems. c) Metastable procedures -- instructional procedures will be designed to be as little subject to the accidents of individual teachers and situations as possible.

To the degree that it has been possible to develop programs with the above special features, they should be relatively successful with many sub-groups of individuals under a variety of circumstances.

Procedures

Basic research in reading is not proposed: knowledge for its own sake will not be pursued; interesting side-issues will not be followed; experimentation will not conform to the conventional experimental-control group paradigms of hypothesis testing. Rather, there will be deliberate application of behavioral technology to a specific job. This is not to deny that there are many unresolved issues in the relevant areas of child development, linguistics, reading methodology, and psychology, but such issues will be dealt with only insofar as they bear directly on the task at hand and where current knowledge does not provide adequate guidelines for action.

Developmental Research. In general, detailed behavioral analyses will be made of various aspects of reading performance. Initial program segments will be developed from these analyses and tried on suitable subjects. Trial of the segments, revision, re-trial, and so on, will continue until each program segment produces a uniformly high level of student performance. These initial program segments will provide the baselines upon which subsequent segments will be developed. The success of later program segments, and the entire set of programs, will depend upon the degree to which the earlier segments teach consistently what they are designed to teach. In other words, a final program of many segments will be built-up through a series of successive approximations in which success of the later sections will rest upon perfections of prior sections. Within each section, student performance will be clearly analyzable and perfectible because disrupting differences in the degree of student preparation (commonly found in conventional instruction) should be non-existent.

Such programs of experimentally demonstrated validity will be constructed through the careful and systematic application of sophisticated behavioral analysis and technology.

Field Validation. Relatively large segments of the programs developed according to the above carefully controlled procedures will be validated by "field testing" the materials under the relatively uncontrolled conditions of practical use. Two aspects of the proposed validation activities are of special interest: follow-up of students to determine success in producing "independent readers" and trials of the programs on special populations not used in the program development (e.g. adult illiterates, children from deprived backgrounds, the mentally defective, and certain non-native English speaking groups). To the degree that it has been possible to develop programs with the special features (a,b, & c), described above, the programs should be relatively successful with such groups. To the degree that such trials are not successful, data will be made available for further development of suitable programs.

End Products. The major product will be a set of self-instructional reading programs along with supporting validation data that specify the results to be expected from use of the programs on specified populations. The necessary instructions for program administration, including detailed diagnostic and criterion measures for guiding students through the programs according to their individual requirements, will accompany the programs.

(A series of journal articles is anticipated describing the program rationale and presenting details and data from the experiments undertaken during program development. A final report, in the typical sense of the word, is not anticipated since all relevant data and rationale will be available with the programs and in the articles planned. If such a report were desired, however, it could be readily assembled from the above materials.)

EMPIRICAL DEVELOPMENT OF A BEGINNING READING SKILL* (11)

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The general purpose of this study was to develop a self-instructional reading program as a vehicle in identifying variables that are crucial in the design of effective materials. The specific objective of the program was to teach children to sound out and read aloud combinations of four initial consonants (*f*, *r*, *s*, and *m*) and four vowel-consonant word-endings (*an*, *it*, *at*, and *in*). The sample consisted of children from the lowest quartile in reading readiness in the low first grade at a school in a culturally deprived neighborhood.

The original version of the program was based on the assumption that children would automatically induce the grapheme-phoneme correspondences if given sufficient exposure to minimal pairs of the trigrams (e.g., *fan*-*fin*). The task was perceived as a sequencing problem: in what order should the words be presented? Initially words were grouped according to common endings, e.g., *man*, *fan*, *ran*. When confronted with a new ending, such as *fit*, the child tended to respond with *fan*, since he had learned with the previous word group that it was sufficient to respond only to the first letter. Grouping words according to common initial letters, e.g., *fit*, *fat*, *fan*, resulted in high error rates and accompanying avoidance behavior. Discrimination items were then inserted that required the child to distinguish word pairs differing on the following letters: the first, last two, final, and then the middle ones, in that order of difficulty. This proved only moderately helpful, so a new cumulative sequencing procedure was used. Each new word was contrasted with all preceding words and then added to the list. This technique yielded increasingly larger repetition intervals as one proceeded through the list.

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Since criterion performance (the ability to read novel combinations that had been excluded from the program) was still not obtained with the latest version of the program, a different strategy was tried. The trigram elements (initial consonants, and vowel-consonant endings) were taught explicitly; it was no longer assumed that the children would automatically induce the letter-sound relationships. The sounds of the beginning letters and the vowel-consonant word-endings were taught independently. But teaching the children to blend or amalgamate the elements to produce the whole word was very difficult.

A wide variety of techniques were tried such as: repartitioning the words at the final consonant, gradually increasing the time interval between the presentation of the sound elements while children responded with the pronunciation of the whole word, and using cardboard aids. A rhythmic sound game proved effective in bringing children's word pronunciations under control of their phoneticization of the word elements. However, they still could not read the novel criterion words.

The transfer problem was finally solved by giving the children practice at unlocking novel combinations (other than the criterion words) within the program. If children had difficulty with these "novel-words-within-the-program," they were branched to remedial exercises designed to assist them in generalizing the decoding skill to the word pattern that was giving them trouble. This procedure was effective and two/thirds of the children subsequently read at least three of the four criterion words.

Three hypotheses were obtained from the empirical development of these materials and were subsequently verified with another set of material and with a different age group:

1. All skills comprising the instructional objective must be developed explicitly within the program.
2. Directions and items requiring responses that are irrelevant to the instructional objective should be eliminated from the program.
3. The child should not be permitted to continue through a program until subskills in previous segments of the program have been completely mastered.

It was proposed that the empirical development of self-instructional reading materials using the iterative procedures described in this study be extended to include letters, words, and sentences.

COMPUTER-BASED INSTRUCTION IN INITIAL READING (14)

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The intent of the project is to explore the manipulative variables that affect reading performance in the primary grades. The experimental work will take place within the confines of a computer-based instructional system. The computer system will provide for complete control of the stimulus materials (audio and visual) via specified performance criteria embedded in the decision network of the program; it also will permit detailed recording of all the students' responses and response times. These fine-grained behavioral histories will be of sufficient duration so that a normative description of initial reading behaviors will be possible. It is anticipated that these empirical findings will provide the basis for the development of quantitative learning models that can describe and interpret the initial reading behaviors in terms of the variables incorporated into both the stimulus materials and the programming structure.

Description of the Stanford computer-based instructional system

This system consists of a medium sized computer and six instructional booths. Each booth is a small 7' x 8' room that contains three input-output devices: (1) an optical display unit, (2) a cathode-ray tube display unit, and (3) an audio system. The main computer controls the presentation of the visual and auditory materials; the students respond with either a light-pen device, a typewriter keyset, or a microphone. The computer evaluates the responses and selects new audio and visual material according to the outcome of the evaluation.

The optical display unit is a rapid, random-access projection device that presents visual material to the student on a 10" x 13" screen. The source of the materials (any 8-1/2" x 11" page of text) is photographed on microfilm and is stored in a small projector cell that has a capacity of 256 pages. Since each display unit has two projectors, each instructional unit has a total capacity of 512 individual pages. Moreover, additional combinations are possible by constructing composite images from both projectors on the common screen or by using the shutter system that divides the screen into eight equal sections by various masking arrangements. The student responds to the display and sends information to the computer with a light-pen. As the pen is touched to the screen, the coordinates of the position are sent to the computer for evaluation according to predefined areas of correct and incorrect responses. Most of the evaluation operations of the optical display unit will occur in approximately one second.

The cathode-ray tube display unit, commonly called a "scope," can present any of 120 prearranged alpha-numeric characters or line vectors on a 10" x 10" screen. A light pen is available for sending information to the computer for evaluation via the specified coordinate system as described for the optical display device. In addition, a typewriter keyboard is attached to each scope and may be used to send information from the student to the computer.

The random-access audio system can play any prerecorded message to the student. The messages are recorded on a 6" wide magnetic tape. Two tape transports are available to each instructional booth. Each transport has a capacity of approximately 17 minutes that can be divided into any combination of message lengths from 1020 one second messages to one message of 17 minutes duration. The student may record onto the tape and then have the recording played back for comparison purposes or retained as response data. The random-access time to any stored message is less than two seconds.

The various control and switching functions between the different input-output terminal devices are handled by a medium sized computer that has a 16,000 word core memory. An additional 4000 word core can be interchanged with any of 32 bands of a magnetic memory drum. All input-output devices are proceeded through a time-sharing program that services them only when necessary. Two high speed data channels permit simultaneous computation and servicing of terminal devices. Additional back-up in computational power, storage, and increased input-output speed is obtained through connections to a larger computer system located at the Stanford Computational Center.

We are now in the process of developing a similar computer-assisted instructional system that will be located in an elementary school. Sixteen instructional stations will be available on the school site. The main computer will be located on the Stanford campus. Telephone lines will be utilized for transmission of information between the computer and the terminals. We plan to provide instruction for approximately 90 students per day with this system.

Current and proposed research activities

The predominant activity of the project during the recent months has been the planning and preparation of reading materials for the computer system. This includes the visual display pages and the audio script necessary for the extensive branching structure planned for each reading lesson. Instead of attempting an extensive description of these reading lessons, a brief resume of the experimental variables that we plan to incorporate into the lesson materials will give a better sense of the project's activities and plans.

Criteria for word mastery. We plan to study the relationship between word mastery and four types of dependent measures: 1) specific correct or error responses to a word in a given lesson, 2) latencies of responses, 3) relative frequencies of correct or error responses to a homogeneous class of words, and 4) sequences of correct and error responses. Numerous combinations of these four dependent measures can be incorporated into the decision structure of the program at various branching points for the purpose of controlling the level of mastery of a given word. In calculating these dependent measures for each individual student and in utilizing them to determine the student's path through the lesson material, one can begin to assess the amount and type of repetition necessary for stipulated levels of mastery. Moreover, the degree of learning may continue to be sensitive to latencies after the student has begun a long sequence of correct responses to a given word (i.e., we have latencies data from young children in a paired-associate task that indicates the continued decrement of latencies even after a given S-R pair has been correctly mastered). Thus we plan to investigate how these four dependent measures reflect different stages in learning in order to gain some understanding of the relationship between repetition and word mastery.

Optimum presentation strategies. The investigation of optimal presentation strategies through the use of mathematical learning models has been a recent theoretical development (Dear and Atkinson, 1962). The typical situation involves teaching a list of words where only a fixed number of presentation is allowed. Contrasting presentation strategies can be formulated in terms of the assumptions about the terminal reward structure and a given learning model. For example, one can distribute the practice equally over all the words or distribute it according to some function defined over the previous response history. Different theoretical formulations about the acquisition and retention processes dictate different presentation strategies. We plan to test a number of different optimization strategies on various word lists that will be included in the lesson material.

Word recognition acquisition rates. A current longitudinal study (Suppes and Hansen, in press) on the acquisition of mathematical concepts by a homogeneous group of bright primary-level students indicates a surprising variation of learning rates. We expect to find similar variation in word recognition rates when students are allowed to proceed at their own pace through the reading curriculum. A more important aspect of acquisition concerns the variations of rates over different classes of words (e.g., how much do the acquisition rates decrease when a child must learn words with vocalic digraphs like year, read, deaf, etc.). Developments in this area may provide behavioral basis for scaling the relative difficulty of certain word classes.

Linguistic units in the initial vocabulary. We have in progress a number of experiments that deal with the relative difficulty of certain graphemic sequences. For example, are final consonant clusters more difficult than clusters in the initial position (e.g., trap vs rapt or stop vs pots)? Do consonant reversals in contrasting words pose a serious learning problem (e.g., pin - nip or tub - but)? Are the letter-to-sound variations due to pre-and-post vocalic "r" (e.g., brad vs bard) a serious learning task? Experiments like these will allow us to assess the relative contribution of proposed linguistic propositions about letter-to-sound correspondence rules, the phono-tactic restrictions of consonants and vowels in words, and the influence of morphophonemic transformation rules.

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BEGINNING READING: AN ECLECTIC PHONIC APPROACH (21)

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It is widely accepted that the number of stimuli presented to beginning readers should be limited or controlled in some fashion. Even Levin and Watson (1963) in their investigation of the "set for variability" hypothesis state "we still would be reluctant to say that the total range of variation should be imposed on the beginning reader at the same time." Control may be gained by limiting graphemes (e.g., Gibson-Richards-MacKinnon), by limiting phonemes (e.g., Buchanan-Sullivan), by limiting number of words (e.g., Scott Foresman readers), or by introducing special stimuli that regularize the grapheme-phoneme relationships (e.g., Pitman's ITA or Gattegno's sound-color system). The proposed system represents an eclectic approach drawing from each of the above and adding certain modifications to facilitate transfer from the special symbols to the standard English orthography.

The proposed symbol system is presented in Table 1. Although it greatly resembles the Pitman system, it differs in the following ways:

1. It is closer to the standard orthography than is the ITA.
2. Fewer symbols are used.
3. Standard orthography is altered to make the symbols more discriminable from one another.
4. No symbol is a mirror image of any other symbol. Nor would any symbol be a mirror image of another if the table were rotated 90°.
5. Special symbols generally correspond to sounds which occur infrequently and in every case bear some resemblance to the "usual" spelling of a particular sound.

Superimposed upon the above system to facilitate transfer from reading in the special orthography to reading in the standard orthography would be a color system where each vowel, diphthong, and certain phonemes which are spelled in a variety of ways would be presented in a specific color. Also, very early in the training procedure, the child would be taught that empty letters, e.g., b , are silent. Thus, if the thirty-first entry, æ, in Table 1 were colored green, a child might learn to read the word GATE as follows:

(green)
↓
Stage 1: gæt
(green)
↓
Stage 2: gate
Stage 3: gate

The word EIGHT would be taught:

(green)
↓
Stage 1: æt
(green)
Stage 2: æight
(green)
Stage 3: ei ght
Stage 4: eight

Early in the training phase, the child would be taught that color is primary so that this method would not teach explicitly all specific sound-symbol combinations, as in the Gattegno system, but rather the color would be expected to act as a mediator in the new learning situation.

In addition to the special symbols, it is proposed that the difficulty of the initial reading tests be further reduced by controlling the introduction of stimuli. The practical alternatives here are phonemes, graphemes, bigrams, trigrams, syllables, and words. Although the frequency of elements in these categories are correlated, the relationship is less than perfect and complete simultaneous control is not possible. Maximum transfer to the "real world situation," for example reading the newspaper, could probably be accomplished by teaching the most frequent elements from each of the above categories first. In the total system, this would result in the child being introduced first to a few phonemes (see Tables 1 and 2) where words are presented in the standard orthography, with which he already has some familiarity, and gradually he would be introduced to the rarer phonemes which are characterized by the special orthography.

The following questions would be most relevant before the system is finalized:

1. What weights should be attached to the various possible frequency controls?
2. At what rate should new material be introduced?
    a. graphemes (special)
    b. phonemes
    c. irregular spellings (color coded)
    d. standard orthography
    e. reading vocabulary
3. What physical characteristics will make graphemes most discriminable?
4. What role should stimulus predifferentiation play in the learning procedure?

5. What kinds of pretraining would facilitate early reading?

6. What mechanical devices or techniques can be produced to facilitate blending?

7. What facilitation can be brought about by context?

Table 2. Rank of letter frequency in prose material. Data from Baddeley (1960)

Rank	Letter
1	E
2	T
3	A
4	O
5	I
6	N
7	S
8	R
9	H
10	L
11	G
12	D
13	C
14	M
15	U
16	F
17	P
18	W
19	Y
20	B
21	V
22	K
23	X
24	Q
25	J
26	Z

Table 1. Special orthography and relative frequency of associated phonemes. Phoneme frequency averaged from Dewey (1923) and Tobias (1959).

a	b	c	d	e	f	g	h	i	j
bat	bat	cat	dog	get	fat	get	hat	bit	jet
3.3	1.63	2.83	4.05	3.10	1.69	1.07	1.65	8.88	0.36
l	m	n	o	p	r	s	t	u	v
log	mat	net	on	pat	rat	sat	at	up	vat
3.66	2.97	7.09	2.06	1.71	6.12	4.15	8.12	2.33	2.02
w	y	z	wh	ch	th'	th	sh	ng	au
wet	yet	zip	white	chat	thick	that	ship	sing	paw
2.41	1.50	2.55	0.20	0.42	0.59	3.53	0.66	1.12	2.48
ae	ee	ie	oe	ue	oo	o͞o	ou	s'	
hate	eat	by	doe	use	book	spoon	out	vision	
1.89	1.99	2.10	1.62	0.31	1.12	1.20	0.63	0.02	
a'	oi								
sofa	oil								
6.61	0.07								

A FRAMEWORK FOR THE ANALYSIS OF EARLY READING BEHAVIOR [1]

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This paper presents a rough classificatory scheme in which the behavior of elementary reading is broken down into a set of interrelated "repertoires" along the general lines of B. F. Skinner's analysis of Verbal Behavior (Skinner, 1957).

Tables 1 and 2 present the basic categories in the taxonomy. The glossary preceding Table 1 explains the symbolism used in the tables. The general scheme is based upon a distinction between referents and symbols. A referent is a nonverbal stimulus: a physical object or event. A symbol is a word or sequence of words. In the present scheme there are two kinds of symbols: spoken and written. Symbols may, of course, occur as stimuli or as responses. A symbol is a verbal stimulus, and a response which produces a symbol is a verbal response. Pointing to a symbol is also a verbal response. Pointing to a referent is considered to be a nonverbal response, and responses which produce objects or events which match referents in one or more properties are also considered to be nonverbal. The basic elements of the taxonomy are thus referents, spoken symbols, and written symbols, and behavior is classified according to the combinations in which these can occur as stimuli and as responses. Each of the nine resulting categories is in turn subdivided into two general types of tasks: selection, or multiple-choice tasks, and free, or constructed-response tasks. These yield the eighteen classifications shown in Tables 1 and 2. "Matching" tasks are collected together in Table 1 and "Association" tasks in Table 2.

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[1] This is an abridged version of a longer paper available, upon request, from Project Literacy.

Figure 1 shows examples of matching tasks which involve nonverbal stimuli and responses, that is, the stimuli are referents and the responses produce objects or events which match them in one or more properties (A-A, Table 1). Shown in the figure are representative items drawn from sets of items which might define various kinds of behavior falling within this general category. In the multiple-choice tasks the sample is displayed at the top. The instructions are phrased in such a way as to indicate the task as clearly as possible to the present reader. In practice, the context and previous training would probably result in the use of instructions which are more elliptical. Although pictures are used as referents in these examples, other tasks might involve actual objects, models, movies and so forth as nonverbal stimuli.

There are many kinds of behavior in this large and fascinating category. Subjects can be required to select or produce matching objects according to various properties or dimensions such as color, shape, size, spatial relations, weight, etc., while other properties are allowed to vary. Auditory stimuli can be matched on the basis of such properties as pitch, rhythm, tone-color and so on. (The task of repeating words in an unknown language falls into this same subgroup.) Complex objects can be matched on the basis of zoological and biological classifications. Note that imitation and mimicry are also in this category.

Figure 2 shows some examples of matching tasks involving written or spoken symbols (a-a and a-a. Table 1). In the first three lines of the figure are tasks of varying complexity involving written symbols. The bottom line of the figure shows a corresponding set-up for spoken symbols. In general these tasks have to do with matching graphemes and sequences of graphemes or phonemes and sequences of phonemes.

Figure 3 shows examples of association tasks which involve nonverbal stimuli and written or spoken responses (A-a and A-a, Table 2). Lines 1 and 2 of the figure show tasks in which the responses are written but at two quite different levels of complexity. Line 3 shows the spoken response task which is parallel to the written response task in line 2. Tasks such as those shown in lines 2 and 3 offer excellent opportunities to study multiple control by verbal and nonverbal stimuli.

Figure 4 shows examples of association tasks involving written or spoken stimuli and nonverbal responses (a-A and a-A, Table 2). Again, the spoken cases in line 3 parallel the written cases in line 2. This kind of material is closely related to conventional tests of paragraph comprehension.

Figure 5 shows examples of association tasks involving written and spoken stimuli and responses (a-a, and a-a, Table 2). In line 1 the stimuli are written and the responses spoken. In line 2 the stimuli are spoken and the responses written.

Figure 6 shows a schematic diagram in which some of the interrelationships among these types of tasks, or classes of behavior, can be examined. In this diagram, the multiple-choice and free-response tasks have been thrown together, leaving nine categories based on the classifications of stimuli and responses (Tables 1 and 2). Tasks in which the responses fall into the same category have been tied together to form small triangles, and these have been arranged so that the symmetrical tasks - those in which the stimuli of one task are the responses of the other and *vice versa* - are placed close together. This leaves the matching tasks at the outside corners of a large triangle composed of the three smaller triangles. The right-hand side of the large triangle thus includes categories of behavior which are involved, in general, in speaking and listening. For example, a small child learns to sort and classify referents (A-A); to point to, or produce, referents under the control of spoken instructions (a-A); to name and describe referents (A-a); and to echo spoken symbols (a-a). The left-hand side of the large triangle is symmetrical with the right but involves written symbols rather than spoken symbols. (There is thus a strong analogy between the deaf-mute child learning to read and the normal child learning to speak.) The base of the large triangle includes categories of behavior which are involved in transcription from spoken to written symbols and *vice versa*.

The categories of behavior which are diagrammed as pairs of circles at the midpoints of the sides of the larger triangle are those which are ordinarily considered as most important in reading. Taken together, the pair at the left and the pair at the bottom constitute the general classes of criterion behavior for reading. The pair at the right defines behavior which is assumed as prerequisite in most reading programs.

Many kinds of behavior, which have been placed in different categories in the model, are shaped at once by the contingencies of reinforcement in the "natural environment" which establish the complex repertoire of the normal speaker, listener, and reader. The program of research suggested by the model involves attempts to set up these (hypothetical) sub-components in isolation and to observe their interactions with one another. To take "reading behavior" apart, in other words, and put it back together. For example, in the natural environment the repertoires of the speaker (A-$\underline{a}$) and of the listener ($\underline{a}$-A) are probably never developed separately, but it might be possible to separate them in the laboratory. One might train a subject until he had acquired a small repertoire of the form $\underline{a}$: A, B (that is until he could choose among referents under spoken instructions). One might then test to see to what extent he automatically, as a result of such training, had acquired the repertoire of the form A: $\underline{a}, \underline{b}$ (choosing among the spoken symbols in the presence of the referent). One might also test the repertoire of the form $A \rightarrow \underline{a}$, $B \rightarrow \underline{b}$. The latter depends for its existence upon a previously established echoic repertoire ($a \rightarrow \underline{a}$, $b \rightarrow \underline{b}$) and one could test or teach it as part of the experiment. A similar experiment would concern "transfer" in the reverse direction.

It is instructive to compare the elements in the foregoing experiments with their counterparts on the left-hand side of the triangle (Fig. 6) where the symbols are written rather than spoken.

One can, of course, design miniature programs of instruction to set up specific, isolated repertoires of behavior. This activity is closely related to the above research. Beyond this, the model suggests other possible programs based on transfer of stimulus control (c. f. Skinner, 1957, p. 67). A previously established stimulus is used to evoke a given response in the presence of new stimulus. The response is then reinforced, and control is shifted to the new stimulus. If, for example, a child can echo spoken words, one can present a written word in conjunction with a spoken word and thus evoke the spoken response in the presence of the written stimulus.

During subsequent training the spoken stimulus may be removed and the text comes to control the spoken response. The general paradigm for this transfer of stimulus control may be diagrammed as follows:

	Diagram	Example
Step 1:	$\underline{a}\rightarrow\underline{a}$	Stimulus: say "mad" Response: mad
	$\underline{b}\rightarrow\underline{b}$	Stimulus: say "sad" Response: sad
Step 2:	$\{\underline{a}, a'\}\rightarrow\underline{a}$	Stimulus: [This is the word "mad"; say it. MAD] Response: mad
	$\{\underline{b}, b'\}\rightarrow\underline{b}$	Stimulus: [This is the word "sad"; say it. SAD] Response: sad
Step 3:	$a\rightarrow\underline{a}$	Stimulus: [Say this word MAD] Response: mad
	$b\rightarrow\underline{b}$	Stimulus: [Say this word SAD] Response: sad

The transfer of control in this diagram can be seen in Figure 5 as a "move" from the lower right-hand corner to the lower left-hand corner of the spoken-response triangle. Some programs of this type have been studied by Popp and Hively (Hively, 1964).

The general paradigm for transfer of stimulus control may be applied to "moves" between any two connected points in the diagram of Figure 6. Such programs may be used for analytical, or for practical, purposes. Few of them have been systematically investigated. Some relevant methodological problems are discussed elsewhere (Hively, 1964).

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Glossary

Capital letters represent nonverbal stimuli (referents).

Lower-case letters represent verbal stimuli (symbols).

Underlined letters represent spoken symbols.

Letters not underlined represent written symbols.

A colon is used to indicate a multiple-choice task. For example, in the situation represented by "$\underline{a}$: A,B", the subject chooses between nonverbal stimuli A and B in response to spoken stimulus $\underline{a}$ (Fig. 4).

An arrow indicates a free response task. For example, in the situation represented by $A \rightarrow \underline{a}$, $B \rightarrow \underline{b}$, the subject emits spoken response $\underline{a}$ in the presence of nonverbal stimulus A and $\underline{b}$ in the presence of B (Fig. 3).

A dash indicates a general classification based only upon properties of the stimuli and responses. To compose a particular task the dash must be transformed into a colon or an arrow. For example, the category a - a consists of tasks in which stimuli and responses are written symbols: this category includes both a: ab and $a \rightarrow a$, $b \rightarrow b$, (Fig. 2).

Table 1

Matching Tasks

General Stimulus and Response Classifications	Multiple-choice Tasks	Free-response Tasks
A - A Nonverbal stimuli and nonverbal responses.	A:A,B Matching-to-sample with nonverbal stimuli.	A→A, B→B Stimuli are nonverbal. Responses produce objects or events which match stimuli in one or more properties.
a - a Written stimuli and written responses	a:a,b Matching-to-sample with written symbols	a→a, b→b Copying written symbols
$\underline{a}$ - $\underline{a}$ Spoken stimuli and spoken responses	$\underline{a}$:$\underline{a}$,$\underline{b}$ Matching-to-sample with spoken symbols	$\underline{a}$→$\underline{a}$, $\underline{b}$→$\underline{b}$ Echoic speech

Table 2

Association Tasks

General Stimulus and Response Classifications	Multiple-choice Tasks	Free-response Tasks
$A - \underline{a}$ Nonverbal stimuli and spoken responses	$A: \underline{a}, \underline{b}$ Selecting broken symbols to fit referents	$A \rightarrow \underline{a}, B \rightarrow \underline{b}$ Producing spoken symbols in the presence of referents.
$\underline{A} - a$ Nonverbal stimuli and written responses	$A: a, b$ Selecting written symbols to fit referents	$A \rightarrow a, B \rightarrow b$ Producing written symbols in the presence of referents.
$\underline{a} - A$ Spoken stimuli and nonverbal responses	$\underline{a}: A, B$ Selecting referents to fit spoken symbols	$\underline{a} \rightarrow A, \underline{b} \rightarrow B$ Stimuli are spoken symbols. Responses produce objects or events which match *referents* in one or more properties.
$a - A$ Written stimuli and nonverbal responses	$a: A, B$ Selecting referents to fit written symbols	$a \rightarrow A, b \rightarrow B$ Stimuli are written symbols. Responses produce objects or events which match *referents* in one or more properties.
$\underline{a} - a$ Spoken stimuli and written responses	$\underline{a}: a, b$ Selecting written symbols to fit spoken symbols	$\underline{a} \rightarrow a, \underline{b} \rightarrow b$ Spoken-to-written transcription
$a - \underline{a}$ Written stimuli and spoken responses	$a: \underline{a}, \underline{b}$ Selecting spoken symbols to fit written symbols	$a \rightarrow \underline{a}, b \rightarrow \underline{b}$ Written-to-spoken transcription

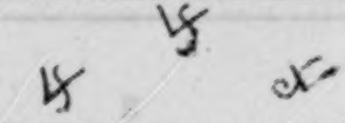
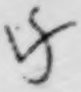
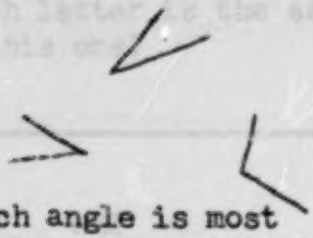
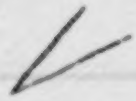
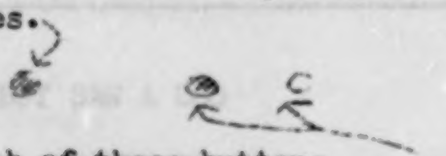
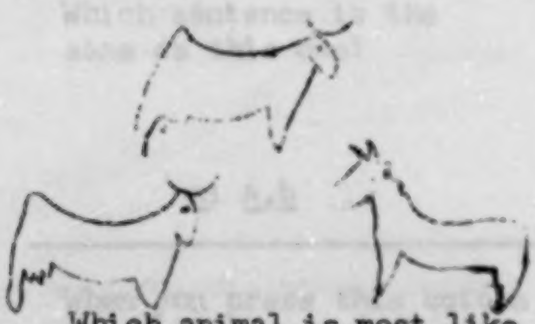
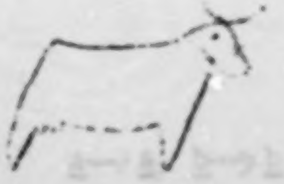
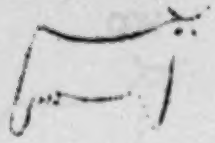
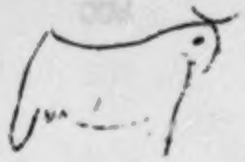
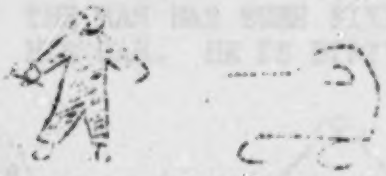
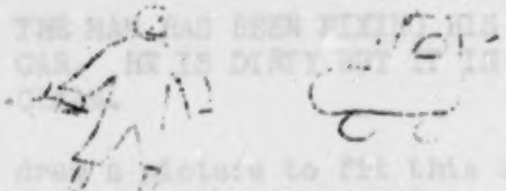
A: A,B	$A \rightarrow A$, $B \rightarrow B$
 Which figure is most like this one?	 Copy this
 which angle is most nearly congruent to this one?	 Construct an angle congruent to this one.
When you press this button you will hear a sequence of tones.  Which of these buttons produces a sequence of tones which is most nearly the same?	When you press this button you will hear a sequence of tones. Sing the same sequence.
 Which animal is most like this one?	 Draw an animal like this. (also: "act like this animal," etc.)

Figure 1: Examples of matching tasks involving nonverbal stimuli and nonverbal responses.

a: a,b	a→a, b→b
E E F Which letter is the same as this one?	E Make this letter
MAT MAT MAP Which word is the same as this one?	MAT Write this word
THE BOY SAW A DOG A BOY SAW THE DOG THE BOY SAW A DOG Which sentence is the same as this one?	THE BOY SAW A DOG Write this sentence

$\underline{a}$: $\underline{a}$,$\underline{b}$	$\underline{a} \rightarrow \underline{a}$, $\underline{b} \rightarrow \underline{b}$
When you press this button you will hear an utterance. Which of these buttons produces the same utterance?	When you press this button you will hear an utterance. Repeat it.

Figure 2: Examples of matching tasks involving written or spoken symbols.

A: a, b	A→a, B→b
 COW HORSE Which word tells what kind of animal this is?	 What kind of animal is this? (write the answer)
 THE MAN HAS BEEN FIXING HIS CAR. HE IS DIRTY. THE MAN HAS BEEN FIXING HIS CAR. IT IS DIRTY. Which paragraph fits the illustration?	 THE MAN HAS BEEN FIXING HIS CAR. _____ IS DIRTY. Put in the missing pronoun. (write the answer)

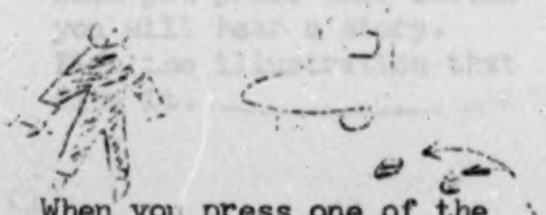
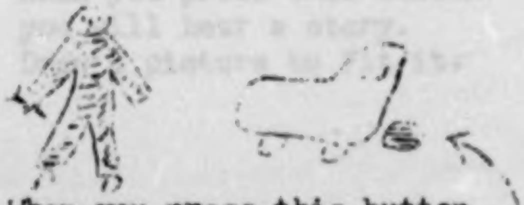
A: a,b	A→a. B→b
 When you press one of the buttons you will hear an utterance. When you press the other one you will hear a different utterance. Which one fits the illustration?	 When you press this button you will hear an utterance. Finish it. (The man has been fixing his car. It is clean but...)

Figure 3: Examples of association tasks involving nonverbal stimuli and written or spoken responses.

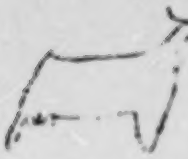
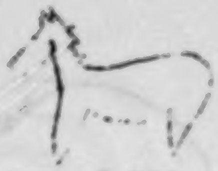
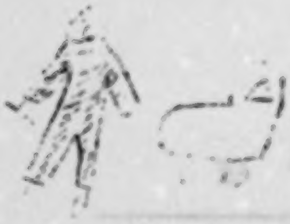
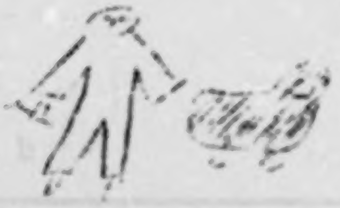
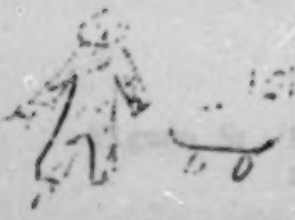
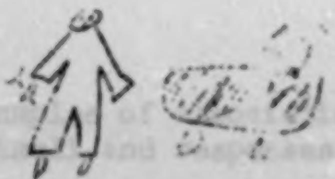
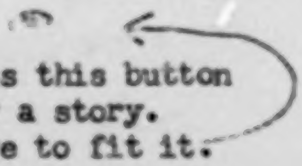
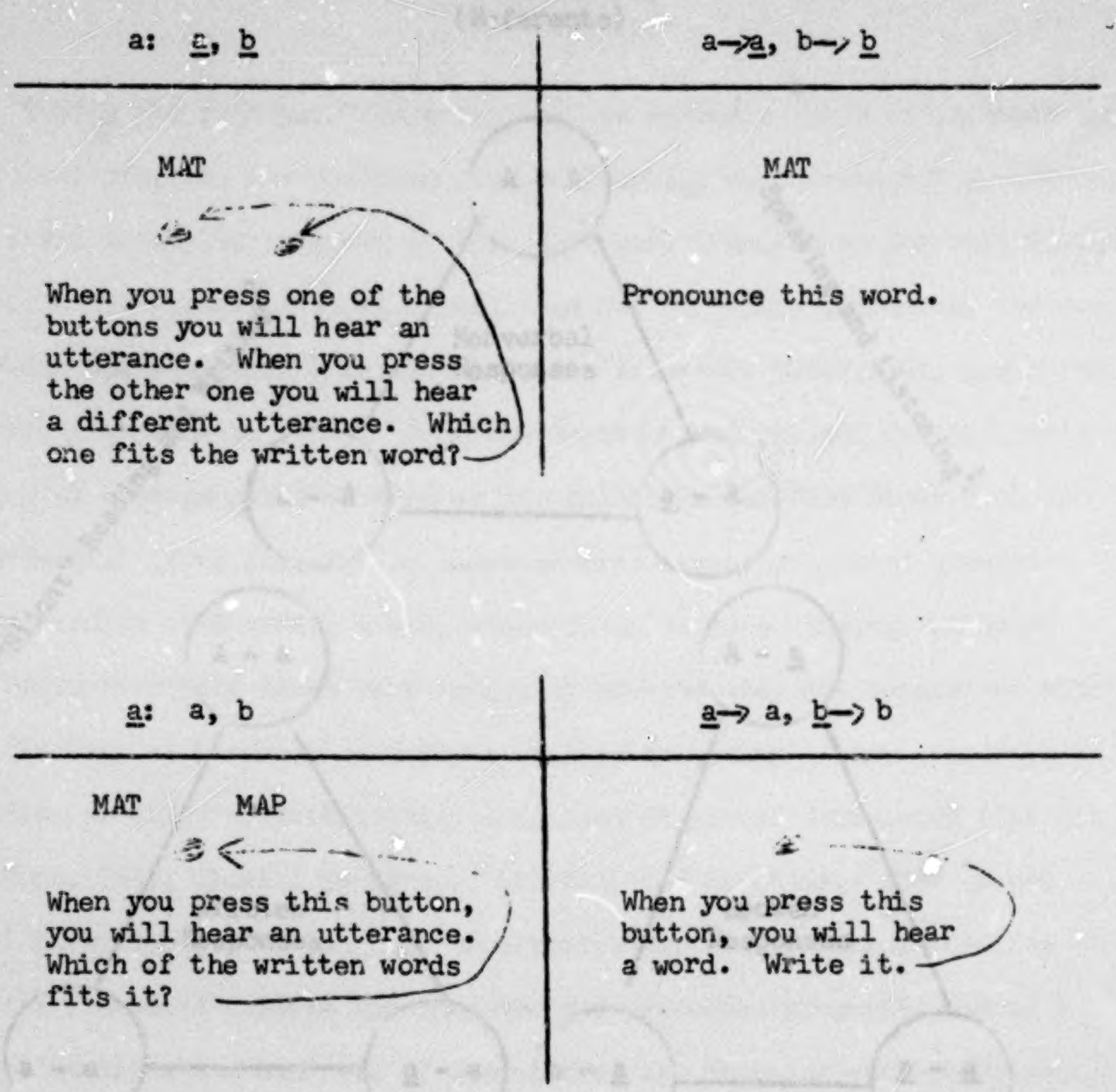
a: AB	a→A, b→B
COW   find the picture that fits the word.	COW Draw one (also: "act like one," etc.)
THE MAN HAS BEEN FIXING HIS CAR. HE IS DIRTY.   find the illustration that fits the story	THE MAN HAS BEEN FIXING HIS CAR. HE IS DIRTY BUT IT IS CLEAN. draw a picture to fit this story.
a AB	a→A, b→B
 When you press this button you will hear a story. Find the illustration that fits it.  	 When you press this button you will hear a story. Draw a picture to fit it.

Figure 4: Examples of association tasks involving written or spoken stimuli and nonverbal responses.



a: $\underline{a}$, $\underline{b}$

MAT

When you press one of the buttons you will hear an utterance. When you press the other one you will hear a different utterance. Which one fits the written word?

$a \rightarrow \underline{a}$, $b \rightarrow \underline{b}$

MAT

Pronounce this word.

$\underline{a}$: a, b

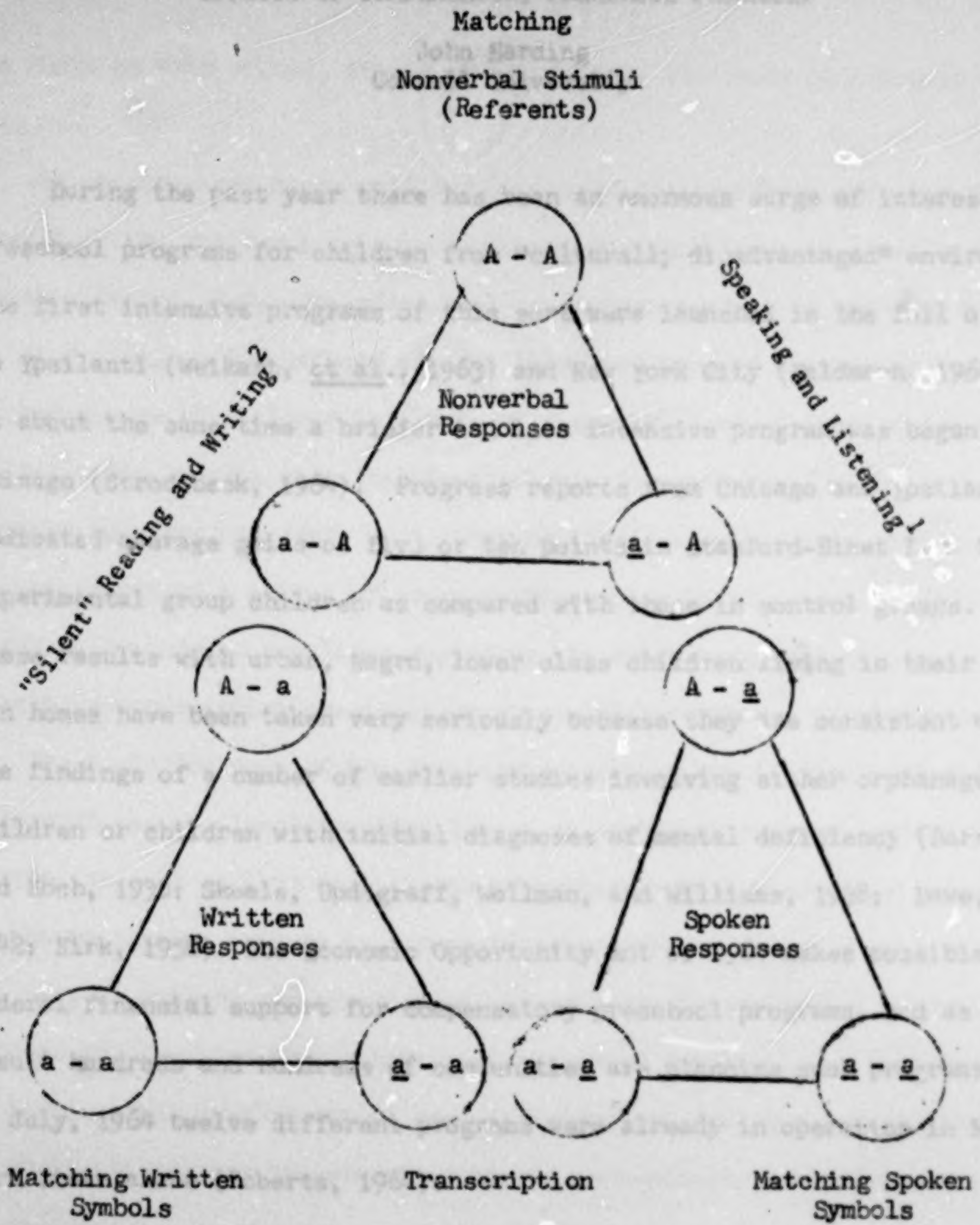
MAT MAP

When you press this button, you will hear an utterance. Which of the written words fits it?

$\underline{a} \rightarrow a$, $\underline{b} \rightarrow b$

When you press this button, you will hear a word. Write it.

Figure 5: Examples of association tasks involving written and spoken stimuli and responses.


Matching
Nonverbal Stimuli
(Referents)
A - A
Nonverbal
Responses
"Silent" Reading and Writing 2
Speaking and Listening 1
a - A
a - A
A - a
A - a
Written
Responses
Spoken
Responses
a - a
a - a
a - a
a - a
Matching Written
Symbols
Transcription
Matching Spoken
Symbols

1. First language learning.
2. Reading for the deaf.

Figure 6: Interrelationships among the tasks in reading.

EFFECTS OF COMPENSATORY PRESCHOOL PROGRAMS

John Harding
Cornell University

During the past year there has been an enormous surge of interest in preschool programs for children from "culturally disadvantaged" environments. The first intensive programs of this sort were launched in the fall of 1962 in Ypsilanti (Weikart, et al., 1963) and New York City (Feldmann, 1964). At about the same time a briefer and less intensive program was begun in Chicago (Strodtbeck, 1964). Progress reports from Chicago and Ypsilanti indicated average gains of five or ten points in Stanford-Binet I.Q. in experimental group children as compared with those in control groups. These results with urban, Negro, lower class children living in their own homes have been taken very seriously because they are consistent with the findings of a number of earlier studies involving either orphanage children or children with initial diagnoses of mental deficiency (Barrett and Koch, 1930: Skeels, Updegraff, Wellman, and Williams, 1938: Dawe, 1942: Kirk, 1958). The Economic Opportunity Act of 1964 makes possible federal financial support for compensatory preschool programs, and as a result hundreds and hundreds of communities are planning such programs. In July, 1964 twelve different programs were already in operation in New York State alone (Roberts, 1964).

The raging torrent of action programs is being accompanied by a slender trickle of research on their effects. All three of the action programs begun in 1962 contain some provision for continuing research on their effectiveness. The New York State Bureau of School Programs Evaluation is attempting to compare the effectiveness of the various programs now in operation in that state. No other active research projects are known to this writer, though it is probable that much planning is going on.

My own research plans call for an investigation of the effects of a program of the Ypsilanti type on Negro and white children in a small city, probably Ithaca, N.Y. The major goal of the research is to build up a body of information on the effects of a well-defined type of program on two well-defined groups of children in a carefully specified educational and community setting. The results will then be available for comparison with those achieved by other programs, with other children, in other community settings. The end result of a series of coordinated studies in this area should be a fairly solid body of knowledge regarding the short-range and long-range effects of compensatory preschool programs under a variety of circumstances.

The basic features of the Ypsilanti operation are (1) the introduction of heavy doses of direct teaching into a conventional nursery school program, and (2) regular home visits by nursery school teachers with an attempt to involve mothers in a home teaching program. In its original form this program employs one experienced nursery school teacher for every six children and involves weekly home visits planned around the current interests and intellectual development of each individual child. The general form of the Ypsilanti program is determined by two assumptions, both of which are extremely well supported in the research literature: (1) the major area of intellectual and academic deficit for the culturally disadvantaged child is language (Milner, 1951; Sexton, 1961; Barton, 1962; Riessman, 1962); (2) language skills develop mainly through sympathetic verbal interaction with a loved and trusted adult (Milner, 1951; McCarthy, 1954; Irwin, 1960).

A question of great practical importance is whether it is possible to preserve the essential features of the Ypsilanti program while reducing its operating costs. I plan to investigate a program with a ten to one child-teacher ratio. During the morning school sessions each teacher would be assisted by one or two middle class community volunteers, or by college girls enrolled in child development courses requiring extensive participation with children. Afternoons would be reserved for home visits; each one would be lengthy and carefully planned, as in the Ypsilanti program, but they would be made at bi-weekly intervals.

The simplest objective criterion of cultural disadvantage is number of school years completed by the mother. This measure correlates as well with child's I.Q. as any other index based on family background or current environmental circumstances (Jones, 1946). I would expect the relationship to be even closer between maternal education and child's school achievement, but I have not had time to search for evidence on this point. The program I am planning would involve children whose mothers had completed eight years of schooling or less, and whose fathers (if present in the home) had not attended college.

A geographical area large enough to include forty or fifty such children in the four year old age bracket is to be defined within the limits of a central city. The children are to be identified in the course of the census made by most New York State school districts each year for planning purposes. At the time of the census arrangements will be made for initial administration of the WISC and Stanford-Binet.

Two programs will actually be operated at the preschool center. The morning program, for twenty children, has already been described. An afternoon program will also be available for a maximum of twenty children. This program will be of a minimal nature, with one experienced teacher assisted by community volunteers. No home visits or parent activities will be included for children in the afternoon program. Free transportation will be provided for children in the morning program, but not in the afternoon program.

In discussing these programs with parents two major points will be made: (1) the goal of each program is to help a child to get off to a good start in kindergarten, with the expectation that this in turn will help him to do well in school later on; (2) we are trying to find out how much difference these programs make, so it will be necessary to give the children some tests before they start and leave to the school staff the decision about which program a child is assigned to. If a child is assigned to the morning program he will be expected to attend regularly throughout the year except when he is sick. If he is assigned to the afternoon program he may attend as frequently or infrequently as he and his parents wish.

Actual assignment of children to the two programs will be on a random basis, subject to frequency matching of the two groups on sex, color, and distance from the preschool center. The morning group with its twenty children will be the basic experimental group for the research. Both groups will be followed for a five year period, with individual intelligence tests repeated at the end of the first year and at the end of five years. For the experimental group there will be repeated administration of various kinds of perceptual and language tests during the nursery school program.

Records of activities in the nursery school will be kept by the teachers and by two graduate assistants. The two teachers in the experimental group will keep records of their home visits and will make systematic ratings of home atmosphere on eight or ten of the Fels Parent Behavior Scales. As the final part of the experimental program the nursery school teacher who has been working with a particular family will accompany the child's mother on her first visit to the kindergarten to which her child will be assigned during the following year, and will attempt to aid in the establishment of a good relationship with the kindergarten teacher.

Three groups of children will be available for comparison with the experimental group. First, there will be the matched children from the same neighborhood enrolled (at least nominally) in the preschool afternoon program. Second, there will be all the children in the same age bracket as the experimental group and with the same level of maternal education but living outside the district served by the preschool center. Third, there will be older children from culturally disadvantaged homes in the district served by the preschool center. For groups two and three the only test results available will be those on the group tests regularly administered in the school program. Fortunately this program is an extensive one, at least in the Ithaca school system. It includes both group intelligence tests and a wide variety of achievement tests.

It is planned to continue the preschool program on the same basis for a number of years -- probably three -- to permit pooling of data for successive years. At least fifty cases will be required to enable tentative conclusions to be drawn about the effects of this particular type of program on culturally disadvantaged Negro and white children in a community without any obvious Negro ghetto.

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PROPOSAL FOR STUDY OF VARIOUS ASPECTS OF TEACHING EFFECTIVENESS WITH CHILDREN OF DIFFERING CHARACTERISTICS

Pauline S. Sears
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The development of teaching effectiveness requires a firm undergirding of sound knowledge in a) what kinds of teacher behavior (or other instructional media) are associated with b) what kinds of learnings in c) what kinds of children. Study of the development of literacy in children of differing characteristics in terms of social class and home language experience was proposed at the conference. Three types of work were proposed as examples.

1. Language experience of socially underprivileged children:

Currently the relation of preschool children's language experience to their later school performance is of much interest. This question involves comparison of the so-called "culturally deprived" with middle-class children at the earliest stages of language development, with emphasis on the motivational origins and correlates of such development in the early years, in both family and community. One hypothesis is that patterns, or networks of thinking and communication are established by age two or shortly thereafter, and may not be easily subject to modification by primary grade teachers (four years later) who use current methods of teaching perhaps better suited to middle-class than to lower-class children. The proposed work would involve development of observational methods for measurement of young children's language interaction with parents, teachers, and peers. A good start has been made on this by Bernstein of the University of London, who, although a linguist, has made some shrewd observations of language development within the social context of the family. Also, Roger Brown of Harvard, Ruth Weir of Stanford, Robert Hess of Chicago, and Susan Gray of George Peabody, have contributed a number of provocative suggestions concerning the influence of family inspired language habits on thinking patterns. The work contemplated would extend this type of analysis to young California Negro children and their mothers and teachers. Slobin's paper in a previous report is of interest here.

2. Teacher behavior and children's divergent thinking:

What teacher behaviors are associated with gains in children's so-called "creative thinking" abilities, i.e. originality, flexibility, fluency, productivity, etc.? Earlier work (Sears, Spaulding, Sherman) has shown promising relationships between teacher behaviors and gains in divergent thinking in the children exposed to such behaviors, some of these relationships being replicated on two or three different samples. New work is needed in which experimental adoption of high frequencies of categories of behavior shown earlier to relate to divergent thinking is tested against experimentally assumed low frequencies of such categories of behavior by role-playing teachers. Further, the earlier work showed relationships of these kinds to obtain only in bright (above the class median in intelligence) children. This point needs further clarification.

Other questions in this area relate teacher behavior to other goals of elementary education in addition to so-called creativity: gains in academic achievement, attitudes toward academic activities, self-concepts, liking for other children, task-oriented classroom behavior. Techniques for measurement of these, as well as for measurement of teacher behavior, are available from the earlier work.

3. Sex differences in academic achievement:

There is by now clear evidence that five- to eight-year-old girls make a much readier adjustment to school, and achieve considerably more, than boys at the same ages. However, a recent study (McNeil, Amer. Educ. Res. J., 1964, 113-121) finds boy kindergarteners learning to read equally as well as girls under auto-instructional procedures. The same boys did less well than the girls when instructed by teachers in small reading groups. Why is this, if it is indeed true? A question under this rubric involves the development of sex-appropriate behaviors as seen by children and by teachers. Various types of instructional procedures may prove beneficial. Previous research by Anastasi has provided material here. Work now progressing at Stanford, directed by Patrick Suppes and Richard Atkinson on computer based learning with different kinds of children, will be of value in this connection. This research promises to make a real breakthrough in possible provision for individual differences in instructional procedures for children of different sexes, abilities, and past experiences (including poverty of language usage).

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WHAT IS PROJECT LITERACY?

Project Literacy was organized at Cornell University on February 1, 1964, by a developmental projects award from the Cooperative Research Branch of the United State Office of Education. This project represents one of the major commitments of the Office of Education to basic research and curriculum development concerning both child and adult literacy.

The purpose of Project Literacy is to organize, in various universities, laboratories and state departments of education, research which is essential to understand the acquisition of reading skills. The major initial effort is to bring together researchers and educators from a variety of disciplines to plan research which, when taken as a whole, will give us more substantial results than any single study can provide. Each investigator in the research consortium will be completely responsible for his own activities. The project will provide mechanisms whereby the individual scientists can communicate their research strategies, problems and results to each other and when necessary they will be able to meet together. The research findings will be brought to bear on curriculum developments. When called upon, Project Literacy can provide technical research consultation. The group at Cornell University will also undertake a program of studies similar to those which will be initiated in other settings.

We believe that much current and potential research in learning psychology, visual perception, cognitive behavior, neurophysiology of vision, child development, descriptive linguistics, psycholinguistics, the sociology of educational innovation, research with culturally disadvantaged children and programmed instruction (to cite some examples) are essential to understanding literacy. Consequently, we are endeavoring to locate research interests which heretofore may not have been considered relevant to this crucial educational research area.

REPORT OF THE FIRST GRADE STUDY

Lynette K. Friedrich and Rose-Marie Weber

Part One

This study was not an attempt to test formal hypotheses on the nature of the reading process but rather to observe the daily activities of a teacher and her first grade class as they learn to read. The research was carried out by a psychologist and a linguist in the Ithaca City School District. The class of about twenty students, half boys, half girls, ranged in age from 5.8 to 7.2 years with a mean of 6.3 at the beginning of the academic year. Instruction began September 12, 1964, and ended June 18, 1965. The teacher followed her usual plans and based the reading curriculum on the New Basic Readers (1950 series) of Scott, Foresman and Company.

Three major areas of concentration evolved:

- I. Assessment of children's backgrounds and abilities.
    - A. Test to determine which children could identify letters or some common words on entering school.
    - B. Test to determine children's ability to isolate speech sounds.
    - C. Interviews with mothers concerning family background and child's experience with tasks related to reading.
    - D. Administration of Stanford-Binet Intelligence Tests and Bender-Gestalt Tests.
- II. Intensive observation of small-group reading instruction.
    - A. Structure of the reading session.
    - B. Notation of children's performances in oral reading, including nature and frequency of errors, and teacher's responses to them.
    - C. Bimonthly assessment of progress of individuals and groups.
- III. Recording of individuals' performances.
    - A. Weekly individual reading of both old and new material.
    - B. Free speech of children, especially of four selected children.

I. Assessment of Children's Backgrounds and Abilities

A. Technique for Identification of Readers

On September 13th, the second day of school, the children were given individual trials on a test devised to discover which children entering first grade had already acquired reading skills--ability to match and identify letters, ability to match a word when it was pointed out in another context, recognition of words in isolation and ability to read whole sentences or parts of sentences.

The "Clappy Test" was so named, for it centered about a large clown called Clappy which was attached to a bulletin board with 7 words printed on balloons around it--dog, happy, hat, shoes, nose, fat, and clown. The children were first asked to identify colors and given some simple counting tasks to put them at ease. They were then asked to match letters and identify them if they could. If they did not know the names, the experimenter told them. They were then asked to find what word says.....and asked six of the seven words printed on the balloons. The word clown was then shown to them in a sentence and they were asked to find this word again on the balloon. A story about Clappy--printed in large letters on a separate piece of paper--was then given to the child. The child was asked if there are any words he knows in it. If the child couldn't identify any of the words or was able to read only part of it, the story was read to the child. The story was:

> I am a funny, fat clown.
> I have big, brown shoes.
> I have a blue hat.
> Can you see my big,
> red nose?
> Am I funny? Yes, I am.

On the basis of the test, four categories were formed. In the first, called "readers", were two children who were able to match and name all letters, match the word clown, read the words printed on the balloons and read parts of the story. The second category "marginal readers" consisted of 7 children who were able to match and name the letters and word and some of whom knew words printed on the balloons and in the story. The seven children in the third category were able to match the word clown but did not know any words. In the fourth category were four children who were only able to match letters and unable to pass any other items on the test.

The predictive value of the test may be seen by a comparison of the child's performance on the "Clappy test" and subsequent placement in reading groups:

Red Group--top	Clappy Category
child A	I
" B	I
" C	II
" D	II
" E	II
" F	II

Green Group--second highest	
child A	II
" B	III
" C	IV
" D	III
" E	III

Yellow Group:	
child A	IV
" B	III
" C	III
" D	----
" E	IV
" F	----
" G (repeater)	II

Orange Group:	
child A	IV
" B	III

I. B. Test on Ability to Isolate and Identify Speech Sounds

This exercise was given in October to find out if a child could identify speech sounds in specified positions in isolated words as same or different, or if he could be trained to do so easily. The first task was to transfer the notion of a position, eicher beginning, end, or middle, from a three-car toy train to a spoken one-syllable word CVC. The next task was to identify as same or different the speech sound in the given position of pairs of words. The final task was for the child to give examples with words exemplifying the sound-position correlation that had been the focus of his attention in the preceding task, first by choosing appropriate names from the labels he gave a set of pictures and then by thinking of some words on his own.

The set of words presented orally by the tester were chosen to provide a range of articulatory similarity. For example, one set of words focussing on the end sounds was the following:

cake	hook
cake	stick
cake	rag
cake	fork
cake	room
cake	cape

Of the three words that end differently from *cake*, *room* differs not only in manner and position of articulation, but also in voice; *cape* is the same at the end in all but position; *rag* is the same in all but (weak) voice. Four sets of words focused on initial consonants, three set on final consonants, and three sets on medial vowels.

Performance on the exercise correlated for the most part with rank in class in reading level. When the task was given and the child was unsuccessful, he was given leads toward succeeding. Throughout the year the teacher used the technique of giving same and different words as a listening exercise. All but two or three children in the class became skilled in responding appropriately.

I. C. Summary of Interviews with Mothers.

Each of the mothers of the children in the first grade class was interviewed. The questions dealt with the educational background of the family and the child's activities in the home relating to school tasks, particularly reading.

When the students are divided into two categories - those reading at and above the grade level and those reading below grade level - the following differences were apparent.

1. Socio-economic level:

There was a marked tendency for better readers to be from families in which the fathers were better educated and had jobs of responsibility and skill.

2. T.V. Watching per Week:

In the group of better readers, 4 of the 11 watched a high amount of T.V. per week (10-18 hours and over per week) while in the lower group 5 of the 7 watched a high amount of T.V. per week.

3. Amount of Family Activity:

In the group of better readers, 10 of the 11 mothers reported weekend family activities or weekend plus daily family activities whereas 5 of the 7 mothers reported in the lower group reported very occasional or seldom planned time together.

4. Nature of Family Activities:

The families of the better readers were more likely to participate in activities such as teaching, working, playing games of skill and reading and activities involving physical games, sports, walks, picnics, etc. Eighteen instances of these activities are recorded. Among the families of the poorer readers there are only 3 instances in the second category of physical activities and none in the first category.

5. Amount the child is read to by family members:

7 of the 11 better readers were regularly read to daily by a family member. None of the poorer readers fell in this category.

6. Amount of time child spends looking at books alone:

7 of the 11 better readers daily or very often spent time looking at books alone - only 1 of the lower group was in this category.

7. Did the child recognize words or letters before school?

10 of the 11 better readers recognized words or letters before school. Only 1 of the lower group recognized some letters and some words before school.

8. Child's Inquiry about Words or Letters:

9 of the 11 better readers frequently asked their parents about words or letters in reading material. Only 3 of the 8 in the lower reading group frequently asked about words or letters.

9. Mother's Satisfactions with the Child:

Mothers of the better readers were more likely to be pleased with their child's curiosity and independence while the mothers of the lower group more frequently mentioned the child's attractiveness in personal relationships, affectionate nature, etc.

In general the better readers had better educated parents who gave their children a good deal of experience and encouragement in areas closely related to school tasks while those in the lower reading group had less interaction with their parents and this interaction did not consist of activities which would aid them in school.

I. D. Summary of Results of Stanford-Binet and Bender Tests

In February and March individual intelligence tests were given to each of the children in the class. There was no problem of rapport, for by this time the children had been accustomed to the presence of the tester in the classroom each day. Stanford-Binet and Bender-Gestalt Tests were administered and the Bender score was obtained by employing the system of Elizabeth Koppitz. An overall comparison of scores by reading group indicated:

	Mean I.Q.	Mean Errors on Bender
Red Group I n= 6	144	2.4
Green Group II n=55	128	5
Yellow Group III n= 7	113	7.7
Orange Group IV n= 2	109	9

II. Intensive Observation of Small-group Reading Instruction.

A. Structure of the Reading Session and Rate of Progress.

In the first month of school the children were assigned to different reading groups on the basis of performance. These groups were observed daily and a record of the work covered and the time spent with the teacher noted. Both the absolute amount of time spent in reading groups with the teacher and the methods of instruction and materials varied by group. November, January, March, and May were looked at in detail in the following summary.

Red Group: This group was made up of 7 of the most advanced students. By the end of November this group had completed the pre-primers and was reading Fun with Dick and Jane and had a minimum reading vocabulary of 74 words. In January they completed this book--vocabulary 174 words. In March they read Our New Friends--total vocabulary 335 words. In May they finished Peppermint Fence (D.C. Heath) 157 pages with an additional 107 new words and were reading Sky Blue (Heath)--76 pages of the total 189 pages--90 of the 178 new words were read. The total minimum number of words these children read with supervision was 532 by the end of May.

This group always had the longest reading session with the teacher--often more than twice as many hours per month as the lowest group. The reading sessions for the month of November (17 days observed) totaled 7 hrs. 39 minutes; January (19 days observed)--8 hrs. 7 minutes;

March (18 days observed)--10 hrs. 13 minutes; May (14 days observed)--5 hrs. 6 minutes. So for no month did the average time spent in reading group fall below a daily average of 22 minutes.

The instruction was characterized by an almost total absence of discussion of pictures, characters, etc. from the beginning of the year. They were given a good deal of independent work in the workbooks so that only a few minutes of the reading group time was spent in instructions and the actual work was done alone. The amount of silent reading and reading of stories at their seats apart from reading group increased throughout the year although no independent program of reading was established. Little time was devoted to word attack skills in the reading group until May when nearly half of the time was spent working on vowel sounds.

The general pattern of instruction for this group was the introduction of new words in a list or imbedded in familiar sentences on the board, followed by oral reading of the story and ending with a few minutes of instruction for the workbook pages to be done alone. Occasionally, when the story had been read silently outside the group, the structure of the story was discussed in the group with an emphasis on sequence, importance of characters, etc. rather than mere description. Independent written work--e.g., writing out sentences about the story read was also given to the group.

Green Group: There were 5 children in this reading group which was the second highest in the class. By the end of November this group was in the last of the pre-primers and had a minimum reading vocabulary of 44 words. In January they were reading Fun with Dick and Jane and had been exposed to 88 words; in March they completed this book and were reading Our New Friends--170 word vocabulary. In May they completed Our New Friends and had a reading vocabulary of 335 words.

Throughout the year this group spent less time with the teacher than did the Red group, however at no time did the average time fall below a 19 minute daily session for the recorded days of the month. In November with 16 days recorded the total time was 6 hrs. 45 minutes; in January--20 days, 6hrs. 27 minutes; in March--13 days, 4 hrs. 32 minutes, and in May--17 days, 7 hrs. 9 minutes.

During the reading session there was always some time spent discussing pictures and characters, but this was a minor part of the instruction. The amount of independent work in the workbooks increased with time although never did the number of pages completed alone reach that of the Red Group. Silent reading also increased during the year and the the children were frequently assigned stories to read apart from reading group; however, these stories were always read aloud later in the group. Very little group time was spent on word attack skills and the general instructional pattern was one of introducing new words on the board in lists or sentences, followed by oral reading or silent reading of a page and then oral reading. Word cards were also employed in the earlier months of the year to introduce new words.

The amount of time used for workbook instructions was higher than that of the Red Group and more detailed instructions given.

Yellow Group: By the beginning of March, two groups--Yellow and Blue--were fused with some changes to form the new Yellow Group. These two earlier groups were quite close in progress and at the end of January the first Yellow group had been exposed to 44 words in readers and the Blue group to 58. The combined Yellow Group was made up of 8 students. This group had a reading vocabulary of 95 words by the end of March and were reading Fun with Dick and Jane. They completed this book in May and had a reading vocabulary of 158 words.

The time spent with the teacher for this group was less than that of the Red Group but not always less than the Green Group. In March with a total of 12 days they spent 5 hrs. 36 min. in reading group. In May with a total of 13 days they had 4 hrs. 39 min. of instruction. However, before March the two independent groups had had av. times ranging from 14 to 18 min. per day. When viewed as a whole, the time spent with the teacher was less than that of the Green Group.

In method of instruction this group differs sharply from the two top groups. The children in this group were still in the pre-primers in January and a substantial amount of the group time was spent discussing pictures and characters. While the amount of independent workbook assignments increased during the year, most of the workbook pages were done during the reading group. There was no silent reading through March and by May some pages were read silently in the reading group but were always followed by oral reading. Some work was done on word attack skills such as sound-letter correspondences but this group was handicapped for many months by a lack of knowledge of the alphabet. Flash cards were used more often with this group than with the Green Group and words and sentences on the board were used to introduce new words. However, in contrast to the higher groups, a great deal of the reading group time was spent in discussion of pictures and in group work in the workbook. By May, the group time was spent largely in oral reading, silent reading followed by oral reading and discussions of the meaning of the stories. No written work was assigned to the group.

Orange Group: This is hardly a group for it was largely composed of 2 students although a third student (new) joined later. By the end of November this group had just completed Before We Read and had begun We Look and See--the first of the pre-primers. (vocabulary 7 words). In January they read We Work and Play (30 word vocabulary); in March they finished the pre-primers and read part of the first reader Fun with Dick and Jane (58 word vocabulary). They completed this book and read Guess Who--a supplementary reader at the same level (68 word vocabulary) by the end of May.

The amount of time given to this group was much less than that of other groups despite the fact that they were, from time to time, given two short sessions in a day. Of the 13 days of recorded instruction in November they received a total time with the teacher of 3 hours, 23 minutes (average 15 minutes). In January with 19 days they received 4 hours, 44 minutes (15 minutes average); In March - 18 days, 7 hours, 34 minutes (21 minutes average); and in May - 13 days, 3 hours, 45 minutes (17 minute average). The spent therefore, only half the hours the Red Group spent in reading group in November, January, and May and 3/4 the time in March.

For six months, the instruction for this group was almost totally devoted to discussion of pictures, characters and vocabulary. There were many demonstrations of meaning, that is, activities calling for extraneous movements and analogies. Reading sessions were frequently devoted exclusively to group work in the workbooks, the workbooks were seldom used individually. In May some silent reading was done. Word lists and sentences on the board and word cards were used to introduce new words. Frequently pages were re-read on subsequent days. By the end of May there was still nearly as much time spent in discussion as in oral reading. Some word attack skills such as rhyming and sound-letter correspondences were employed, but until May the amount of time spent was negligible. In May a total of 25 minutes of the total 3 hours and 45 minutes of instruction were spent in rhyming exercises and 9 minutes in sound-letter correspondences.

II. B. Analysis of Reading Errors

For most of the year, a record was kept of the amount each child read silently, as well as the pages and lines that he read orally in reading group. The errors were noted--no response, substitution of word, omission of word, and so on. Moreover, for much of the year we have noted the way in which the child came finally to give the correct response, e.g., the teacher provides the word or calls on another child to provide the word; she gives contextual cues; she gives phonic cues. These notes as well as taped performances of the children have yet to be analyzed.

Our major hypothesis is that the types of errors children make are, among other things, a function of the children's training and skill. Some are also a function of the materials-- format or linguistic structure

The techniques of correction also differed according to the ability of the child; hopefully some study of this will lead to cogent suggestions for the classroom teacher.

In an attempt to code the performance of a child, the following was noted:

1. Book, pages and lines read.
2. Error and its position (e.g., 1.3, oh for look; inserts pretty after the).
3. Who stops the child if he makes the error: teacher or child himself.
4. Who supplies the correction: teacher, child himself, other child in group.
5. Technique for correction (checked if used; if teacher only supplies word, only no. 4 checked): phonetic; context, configuration.

II. C. Progress of Individuals and Groups.

About twice a month the observers noted the progress that each group had made in reading for the previous two weeks, summarizing their achievement. Moreover, the progress of each child, not only in reading, but in arithmetic and printing as well, was summarized bimonthly on the basis of overall impressions and daily notes kept on each child. Other kinds of information, especially those that might interfere with or foster learning, such as being able to get along with other children, general comportment in the classroom, interaction with teacher, verbal skills, interest in academic activities, and attention span, were also noted.

III. Recording of individuals' performances.

A. In January weekly tape-recording of each child's oral reading was begun. Each child read two pages; one from a story in the reader that was familiar to the child, and the other a new page with some unfamiliar words, which would be covered during the course of the next week's instruction. The following week this page was read as the familiar one and another new page was read. Thus for each selection we have two readings: when the page was new to the child and when it was familiar to him. Each member of a group read the same pages. The child was alone with only the linguist while the rest of the class was discussing the weather and composing the newspaper. In April the children were taught to turn off the tape recorder on their own; from then on they read the familiar page completely alone. These materials have yet to be analyzed, particularly for types of errors and for "reading style," expecially stress and intonation.

B. The linguistic performance of the children was noted and some was recorded, especially that of four selected children: a highly verbal, academically successful girl, a not-so-verbal but also successful boy, a somewhat verbal boy with lower academic performance, and a quiet girl with fair performance. No tests were given for linguistic competence. Their speech under various circumstances--talking to other children, sharing in front of the class, talking to the teacher and the observers, retelling a story they had read, and dictating sentences for the daily newspaper--was recorded, especially with the intention of seeing how children adjust their linguistic performance to these situations. These materials have yet to be analyzed.

Part Two - Recommendations

I. Reading Readiness

The Scott-Foresman readiness program is one which is almost totally devoted to interpretation of ambiguous pictures with presumptuous titles of aims. The "analogous" tasks chosen to teach children to distinguish critical features and matching have nothing to do with letters of words and lead teachers and students into prolonged discussions which have no direct relevance to decoding. There is no attempt to present writing as a communicative system or reading as a search for information. There is no presentation of speech-writing correspondences and a negligible amount of material on auditory discrimination. One small workbook page is supposed to accomplish a myriad of training but the result is much more a "hit and run" exposure to ideas and a concentration on time-consuming directions which must be explained by the teacher.

Recommendations:

The readiness program should be aimed specifically at the reading task. Tasks of matching and training for discrimination of critical features can as well be done directly with letters, lower versus upper case, etc. from the first day of instruction. In addition, the teaching of vocabulary necessary for reading should be limited to the task at hand--e.g. top-bottom, left-right, first-last, line, page etc. and the time involved in this instruction geared to the needs of the particular students. These necessary concepts, however, can also be taught employing letters and words as easily as they can be with pictures and thus better serve the end of learning to break the code.

Children should also profit from a program which includes, initially, an explanation of the relationship between writing and speech and demonstrations and exercises in various forms of coding in communication.

While all children should be given drill in distinguishing letters, naming the letters and sound-letter correspondences, the intensity of the drill should be geared to the specific needs of the children. It may be helpful, therefore, to teachers to have at hand various diagnostic tools to determine which children have difficulty with sound discriminations and visual discriminations, as well as left-right confusion and possible visual reversals.

Perhaps a more detailed note should be included about the learning of the alphabet as this task is introduced quite late in the Scott-Foresman program. From our early test to find readers and from the parent interviews, we found that those children who knew their letters upon entering first grade remained in the fastest reading groups. No drill in visual discrimination or in associating names with the letters was given.

The only kind of specific practice was in naming the letters from words familiar to the class. The children were rarely asked to spell orally without the written forms before them. Through January, there were still several children who were unsure of the names of the letters and never became thoroughly familiar with all of the letters of the alphabet. Therefore, in the readiness program recommended above all children would be given specific instruction in associating the names of the letters with the shapes from the beginning of the year. It is assumed, therefore, that associating letters with sounds will then be a less difficult task.

II. Play Area

Perhaps the most salient contribution to classroom atmosphere was the play area. This area in the back corner of the room was filled with stimulating and attractive toys, including tinker toys, blocks, cars, trains, etc. When the children had finished their seat work, they were allowed to go to this corner to play. In general, there were two detrimental effects of this practice:

1) There were no rules about length of time in the play area so that in practice the brightest, most mature children who finished their work first spent the longest time playing each morning. Those who might have profited academically by a break in tasks requiring attention and long concentration had little free time to go there. Most children hurried through their seatwork in order to reach this area and it lead to a neglect of careful work as well as a problem of morale for children who could not finish their work quickly.

2) The nature of the toys available in the play area lead to a great deal of noisy play so that the reading groups were frequently interrupted by the teacher reprimanding those in the back, and by the noise itself. In addition it became necessary for the teacher to look over the seat work to see if it was passable so that the reading groups were also interrupted by children coming to have their work checked.

Recommendations:

It is apparent that some of the children do need a break from concentrated tasks and the concept of independent activity seems a good one for the children as well as an essential one for a teacher trying to hold several small reading groups during the morning. However, if the play or free activities offered were less attractive --i.e. painting, clay, puzzles, etc.--rather than blocks, cars, trains, etc. it would be simpler to plan this free time to meet the individual needs of the children. For those children who are more mature and can concentrate for long periods of time, this free time could be geared toward independent reading in many areas. And for those who need the time away from academic tasks, there might be a set time in which they can paint or work with clay,etc. so that they would not feel that they must rush through their seat work.

The other obvious advantage of these kinds of structured "free time" activities is that the general noise and constant interruptions of reading groups would be minimized.

III. Activities Related to Reading:

A. Sound Discrimination and Sound-Letter Correspondences Training:

The whole class was given instruction in hearing sames and differences in given positions in words, especially in the first half of the year. In December and January, the teacher made large sound-letter charts by presenting a letter, associating it with a key word that begins with the usual sound-letter correspondence, and eliciting words from the children that begin in the same way. Charts were made for all of the letters, but only with one sound correspondence each. While a good deal of interest was generated by the exercise, the members of the two top reading groups were the most active contributors.

B. Regular A.M. Seatwork and Independent Reading:

From November until June, one regular task was the composition of a newspaper--sentences dictated to the teacher by the children--which was copied by all of the class. In addition to the newspaper, there was also an assignment in the workbooks, but the number of pages and complexity of the work varied with the reading group. Some independent reading was given to children in the top reading groups and all had some experience with oral reading in pairs.

Recommendations:

A. Seatwork:
Each morning about twenty minutes of class time was spent in preparing the children for their seatwork. The general result was that the bright children were "over-instructed" while the slower children were sometimes unsure of the directions. While the newspaper was an interesting device for printing and, later, for some independent composition, it also tended to be a very time-consuming daily task which was too simple for the better students and often too lengthy for the slower ones.

The workbooks which accompany the Scott-Foresman reading books are largely a waste of time. They are cluttered with distracting and complicated pictures which are intimately tied to the task which the child must do. Consequently, the teacher must explain the pictures as well as the cognitive task if the children are to do this work. Many of the pages are too complicated to be done independently, which results in a loss of time for both children and teacher. The assignments are often inadequate in furnishing practice in certain tasks and the teacher must supplement this work in reading group. A good deal of time, therefore, is spent simply instructing the children in complicated tasks which are often inadequate in scope or limited in value.

It would be an impossible task for a teacher to compose graduated work for all of the children during the course of the school year. However, if materials were available to the teacher which would be largely self-instructional and carefully graded, the children might be able to profit far more from the experience. With such materials, the teacher could see quickly which children needed supplementary work in a certain area and which ones were able to go on to other work. These materials could also be helpful to the teacher in reading-group placement.

B. Independent Reading and Reading in Pairs:

Little independent reading was done by the lower reading groups and the better readers were given assignments only in their regular texts. The general atmosphere of the room was not conducive to actual "independent" reading of library books as the competing activities were too attractive and noisy. While specific suggestions for independent reading are given in another section, it may be said that a structured reading program which furnishes a wide range of books both by topic and by ability is thought to be essential.

The teacher gave no instructions to the children about reading in pairs. She selected children (from the same reading group) by twos and told them to read a certain assignment--old material from the readers. Due to the lack of structure, sometimes one child would dominate the other, that is, read the entire story aloud, and at other times the child not reading would not pay attention. Errors frequently went uncorrected.

Reading in pairs may be a most helpful technique, especially when it is begun early in the year, possibly with materials other than readers, and specific instructions on sharing and making corrections are given. Further, skilled readers may be paired with children who are more unsure of words in order to give the children in the lower groups experience with material that they could not read alone with competence.

C. Creative Writing:

The children were requested to write some original sentences for their newspapers beginning about March and also began to write stories about group trips or experiences or pictures placed in the room about the same time. These stories were generally composed by the group although some children were able to write many original sentences. The teacher's technique was to write on the board all of the words the children requested.

We feel that creative writing can be a highly interesting and profitable experience. Perhaps for the first attempts, simple paraphrasing of stories using the book as a model might be useful. Later, however, the children might be actively encouraged to use generative skills (sound-letter correspondences) even though they may spell incorrectly rather than simply copy the words they wish to use. When this activity is begun early in the year and the children gain facility with sound-letter correspondences, not only will they have gained experience in composition but also in spelling.

IV. The Content of Reading Instruction

Many of the criticisms of reading instruction included in this section are a function of the basal reading series for the first grade and of the specific guidelines for the teacher furnished by the accompanying Teacher's Manual. The Scott-Foresman Teacher's Manual stresses the use of endless questions aimed at the child's comprehension and interpretation of pictures and at relating the story to the child's experience. Exercises in word attack skills are postponed until late in the year and then are only fragmentary. The vocabulary, while limited and repetitive, is not patterned in a manner which furnishes generative cues. The stories are generally dialogue within narrative. The somewhat difficult format, often spliced with quotation marks, is not conducive to oral reading in which the children take roles. The pictures are complex, misleading, and often provide the story line. The language is unnatural, uncommunicative, and inappropriate to the event depicted.

Improvements might be made along the following lines: In general, instruction in the reading group should be aimed at developing skills directly related to the reading task. Particularly at the beginning of the year we feel that time in the reading group should be devoted to breaking the code through extensive drill with letter matching, training in letter discrimination and relating letters to sounds rather than "analogous" matching tasks or prolonged discussion of pictures for comprehension and vocabulary building.

One of the primary tasks, then, should be the learning of the main correspondences between sounds and letters. This task, of course, requires some prior skill in discriminating among the significant sound units and among the letters. Training in auditory discrimination might move in this direction: First, the child imitates the model of the teacher in saying carefully chosen pairs of words and is directed toward judging whether or not the words are the same or different in a given position. (The choice of items might be determined by differences in articulatory features and by how well the production of the sound can be seen and felt.) Then the child can go on to discriminating some differences in his own speech--but on the basis of words he says in response to selected pictures or actions. A final step would be to ask the child to supply a word that is the same as another in a given sound feature. These kinds of exercises could be done without isolating sounds, although isolation probably helps a child to learn the boundaries of what to listen for. Comparable steps in the discrimination of letters could be made as part of the readiness program, or even as the child is being exposed to reading materials. How best to teach the association between sound and shape is an open question. We make no firm suggestions. However, most consonant correspondences are probably easier to learn than vowel associations. One can more easily see and feel consonants being made and the correspondences are more regular. The assumption that this kind of training is boring to children cannot be defended, especially when exercises are fast-moving and when all of the children have an opportunity to participate.

Because the time in the reading session is so limited, we feel that the more independent reading the child can do, the better. There are, however, two obvious problems: 1) maintaining attention and comprehension 2) dealing with new words. For the first, we suggest paper work of various kinds--filling in blanks, answering questions, etc. which become progressively open-ended as the children become more skilled in both reading and writing until, ultimately, the children may be writing summaries,"commentaries" or paraphrases of the stories. For the second problem, we suggest that an analysis of the new words to be read in the story should be directed by the teacher in the group reading session. In the course of the year, the relative amount of time devoted to the analysis of new words in the reading group should decrease so that the child, with the aid of clues for word attack prepared by the teacher, could handle new material with confidence. The kinds of hints might include a list of familiar rhyming words, splitting of familiar words into components, and underlining of familiar parts.

As a consequence of an emphasis on word attack skills in the reading group, less time would be devoted to oral reading. However, oral reading is not to be neglected, either as a device for drill on words or phrases for testing mastery of independent reading or in its own right. Both in the techniques of instruction and choice of materials, the prime consideration should be the facilitation of oral reading that most resembles speech. Several notions come to mind. The teacher can establish a good model of stress and intonation for the children to imitate. The materials to be read aloud can be cast in the form of dialogue, employing language which most closely approximates everyday speech. For example, children do not say "cannot" and so should be taught to read what they do say first--"can't". To avoid the distortion of speech, most of the words that usually take weak stress (function words) should be presented or analyzed alone. Articles and prepositions might be introduced as whole words in the context of a phrase and drilled in that form. In addition, the sentences should be arranged on the page so that the child does not give end-of-sentence intonation when he comes to the end of the line.

V. Scheduling

The teacher spent about two hours every day giving instruction in reading. From the point of view of the individual child, the proportion of this time that the teacher spends with him, the intensity of instruction during that time, and the content of the instruction directed to him determine the progress he will make, given his particular capacity to learn.

As the summaries of the progress of each group show, time was unevenly divided among the groups throughout the year. The more advanced groups received more of the teacher's immediate attention than the lower groups did. Of course the length of a session depended on how long the members of the group can attend. On the other hand, it must be said that the more mature children were able to take on independent work earlier. We suggest that the teacher's attention be distributed equally among the groups, if possible, and that the more mature children be given independent tasks in accord with their greater capacity. Moreover, we presume that a schedule allowing two ten-minute sessions rather than one twenty-minute session for a particular group may be profitable. A note should be added about "prime time." In October and November, the highest group in our first grade was receiving instruction the first in the morning for more than half the times that they met-- a time when both the teacher and children were fresh and when the teacher was not pressed by the need to fit other groups into the remaining time of the morning. Whenever "prime time" might be in a particular classroom, all the groups should have the advantage of it.

For a heterogeneous class, groups are a practical necessity. For a more homogeneous class, a greater proportion of instruction to the entire class in the mechinics of reading may be profitable, ultimately saving time and energy. For faster children, class instruction may be sufficient for them to master the content of the lesson; in the reading group they can go on to other work. For the slower children, instruction in the small group may be a reinforcement (or introduction) to what is presented to the entire class.

In our first grade, group morale was the best in the top group. There were fewer interruptions by other children when the teacher was absorbed in guiding the alert children. She never picked up another task such as correcting seatwork while they were in session. Not only reception by the children, but instruction itself, fell down with the lower groups. A program should provide guides to prevent against the inefficient use of time with the children who may need direction the most. Finally, our summaries of the groups also indicate that some groups spent far more time on tasks specific to acquiring reading than did others. Certainly the proportion of time spent on given tasks should not be the same for all groups, even at a particular level of achievement. A teacher's guide should provide her with some rationale for dividing the daily minutes of instruction according to the needs of a given group of children.

Appendix

I. General Description of First Grade Setting and Activities

A. Classroom:

The spacious classroom was equipped with a piano, phonograph, aquarium, easels and poster paints, and a play area in which there was a variety of toys--large and small--as well as puzzles, wooden blocks, and number games. The children sat at individual noisy desks with unstable chairs which contributed to the number of interruptions and reprimands given daily. There was no library outside the classroom available to the children and about twenty books as well as several sets of supplementary readers were available at a reading table next to the play area in the back of the room.

B. Schedule:

The daily schedule was from 9:00 to 11:30 a.m. and from 12:30 until 3:00 p.m. Reading instruction was primarily in the morning and numbers, art, music, and gym in the afternoon.

A.M.:

The day began with the pledge to the flag and patriotic songs. The date and a description of the weather by the children were written on the blackboard. Almost every day after the first two months of school the teacher wrote a newspaper on the board composed of sentences offered by the children. (During this time weekly tape recordings were made of each child reading alone or with the linguist in the coatroom.)

About 9:30 small-group reading instruction began in one corner of the room. For most of the year the class was divided into four or five reading groups varying in size from two to eight children. Monthly averages of time spent in the group daily ranged from 14 to 28 minutes (see discussion elsewhere). The children not receiving instruction from the teacher were given seatwork assignments. When they had completed their seatwork they were allowed to do whatever they wished--paint, play with toys, read, etc. Generally the children went directly to the play area. The explicit rule was that the reading groups were not to be interrupted. However, some children regularly asked for the teacher's approval of their seatwork. Some children were requested to do this from time to time as they tended to do their work carelessly in order to go to the play area. As the year progressed, the children did more independent work and had relatively less free time while their classmates were in reading group. They were assigned silent reading in their readers and some groups were given additional written work. The entire class also read orally in pairs to one another without supervision. Several children regularly read supplementary readers on their own when they had gained some competence. In general, however, the brighter, more mature children finished their seatwork first and had the greatest amount of free time. But since the play area was so near the reading table and no library period or program for independent reading was established, the free time was rarely spent reading.

Occasionally, the best reading group prepared dramatizations of the stories in their readers and presented them to the class. In addition, children were allowed to read a book which they had brought from home to the class. Only the best readers participated in this program and perhaps six children read during the entire year. For the first months the teacher also read stories to the class, but this was not part of regular routine.

The morning seatwork generally included copying the newspaper from the board and illustrating it with pictures as well as another supplementary task involving numbers, workbood assignments or mimeographs. Mimeographs were used in the first few months of school but later most of the additional seatwork was given on the board. While later in the year there was greater discrepancy among reading groups as to the quantity and complexity of seatwork assigned, all of the students were given longer tasks than had been required in the fall. Each child made a "dictionary" in the spring and often was told to work on it after the first seatwork assignment had been completed. This project became highly individualized, as some students had only two or three words on each page while others had twenty or more.

P.M.:

The afternoon began with a half hour of gym three times a week and for most of the year with Share and Tell the other two days. During this time, the children went to the front of the room to show their classmates something they owned or could do, to tell an anecdote or sing a song. After gym, there was a rest period of about ten minutes in which the children went for drinks (by rows) while a record was played. Typically, a half hour was spent working in the number book--Modern Arithmetic published by Silver Burdett. Once a week during the first half of the year an art teacher came in the afternoon. There were two half-hour music periods a week throughout the year. During the afternoon there were also lessons on sound-letter correspondences. Creative stories were sometimes composed with some sentences written by the teacher and some written independently, the teacher furnishing the spelling for words. On occasion the class wrote "experience charts" about some common topics of interest, discussion of topics, presentation of art projects, etc. Sometimes reading instruction was given to one of the groups in the afternoon. For about a two-month period, for example, the lowest group was given a short period in the morning and another in the afternoon.

II. Reading Lesson

The Scott-Foresman 1950 series for the first grade includes three preprimers, a supplementary preprimer (*Guess Who*), a primer (*Fun with Dick and Jane*), and a first reader (*Our New Friends*). For the most part, the teacher followed the lesson guides in the teacher's manuals, but she thought that some instructions were worthless. The content of the reading session varied somewhat with the type of children and the level of achievement. These variations are discussed in some detail under Part One, II A. However, all students received about the same instruction at the preprimer level, except at different rates. Such a lesson might have the following outlines: The teacher prints several sentences on the blackboard, including the new words in the new (three-page) story to be read. She asks a child to read the first sentence; if he does not know the new word, she supplies it. Another child goes on the next, and so on through the other sentences. The teacher may write the new words on the board separately and then ask the children to match flash cards with the new words and some old words. (Later on, new words are often introduced in lists.) The children are instructed to look at the list of stories in the beginning of the book, give the name of the new story, and find its first page. A child reads the title aloud; perhaps another child reads the first page aloud. Afterwards, and after every other page, the teacher asks questions of this sort: *What's happening?* *Who's talking?* *Who's Jane talking to?* What does *Jane want Sally to do?* *How do you think Sally feels?* *Why does Sally look bigger than Jane in this picture?* She may instruct them to read the next page silently and then ask a child to read, e.g., the line that says Jane's boat is little or the line that tells what color Jane's boat is. Then a child may read the page aloud. At lessons of this type, every child is given a chance to read orally at least a couple of lines. When the story is finished, the workbooks are passed out and the group does a page or so together.

Studies of Oral Reading[1]

I. Words vs. Pseudo Words

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This study is the first of a series on oral reading. The experiments will share a common empirical model and a common analysis of the subskills which comprise the complex process which is reading. The independent variables will be variations of the stimulus materials: words, pseudo words, phrases, sentences, and the like. The dependent response variable will be latency: the period of time between the presentation of the graphic stimulus, and the onset of the subject's verbal response, reading the word or words aloud. In the present study, we also examined the effects of the experimental variations on reading errors, and the relationships between errors in reading and response latency.

For analytic purposes, we think that reading involves two sub-processes which, at least during the period when the skill is unformed, take place in sequence. The first is decoding in which the reader converts written material into associated language. The second process is code use during which the reader converts the decoded writing into information, guides to actions, etc. Our purpose in the present study has been to establish response latency as a valid index to the process of decoding. We chose, therefore, stimulus materials which, on a priori grounds, represented two extreme degrees of difficulty. In addition, the ages of the subjects were chosen to represent various degrees of skill in reading. We reasoned that if latency was responsive to the variations in stimuli and in subjects, we could be confident in its use as a dependent variable in subsequent studies.

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[1] This study was supported by funds from the Cooperative Research Program, U.S. Office of Education.

[2] We wish to thank Miss Susan Bostwick for her help with this study.

When we originally conceived the present study, it seemed reasonable to expect that words which a child had encountered frequently, either in print or aurally, would be decoded and responded to more rapidly than words which a child had never before encountered. We operationalised this notion by constructing two sets of words, eight "real" words and eight "pseudo" words (e.g., BLERM) and presenting them to second, third, and fourth graders to read aloud.

The validity of response latency as an index of decoding difficulty would be sustained by the following results:

1. Shorter response latencies to real words than to pseudo words.
2. Shorter response latencies associated with higher grade levels in school.
3. Shorter response latencies during the second trial compared to the first.

METHOD

Stimulus materials. The words used appear in Appendix A. The word list was generated as follows:

a. Four initial spelling patterns were selected: BL, CH, GR, ST.

b. Four final spelling patterns were selected: CK, ND, RM, SS.

c. Each initial pattern was combined with each final pattern.

d. By manipulating the vowel letters a and e, two real and two pseudo words were generated for each initial and each final spelling pattern. All words had five letters.

e. Where possible, two words with e and two with a were provided for each spelling pattern. This was not always possible. The vowel o was used in storm as the only possible word meeting criterion (d) above. The word bland was treated as a pseudo-word on the assumption that it would be unfamiliar to most of our sample. We now think this was an error. Three additional words were used as "warm-up" words.

Subjects. We tested 54 children from the West Hill Elementary School[3] in Ithaca, N.Y.. This school serves a population with a wide variation in economic levels. Eighteen children each were drawn from the second, third, and fourth grades. Half of each group of eighteen were boys and half girls. These subgroups were chosen according to "reading ability" by drawing three boys and three girls from the "best" reading group in a class, three, from the "worst who can read" and three, from a group "in between." (We have not reported data for this ability grouping because we do not feel that the assessment is reliable).

Procedure. Each child was informed that "we are getting recordings of how children talk. I'm going to show you a lot of words on the screen and I want you to tell me what they are. We made up some of the words, so you needn't feel badly if you don't know them."

A lapel microphone was attached and the words projected on a screen three feet from the subject. The projected words were about six inches long by two inches high. After the child responded to a word, there was a two second interval before presenting the next word. If the child made no response to a word in fifteen seconds, he was asked, "Would you like to go on to the next one?" (He invariably did.) Similarly, if the child suggested going on, the next word was displayed.

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[3] We are grateful to the staff of the school for their cooperation.

RESULTS

The subject's responses were tape recorded. The tapes were then played through a rectifier which was connected to a pen-writing Brush recorder. This system activates the pen when sound is present and the pen comes to rest during silence. A characteristic sound made by the projector served as a marker indicating the presentation of the stimulus. Latency was measured from this point to the onset of the last word the child gives as a response to that stimulus. All false starts, vocal segregates, etc., are treated as part of the response latency. Omissions were arbitrarily scored as a 12.5 second latency. (We observed that the maximum latency followed by a response was twelve seconds.)

The data were transformed according to the following formula: $x = \log (2.5y - 1)$, where x = transformed score; y = response latency in seconds. This transformation is discussed in Woodworth and Schlosberg (1954, p 39).

The transcription of all tapes was used to make a qualitative analysis of the reading errors. The results of this analysis appear in Appendix B to this paper.

The reliabilities of individual children's response latencies are given in Table 1. Each S read the list twice. The list orders were the same for all children. Subjects were quite consistent from trial to trial, although, as will be seen shortly, the mean latencies decreased over trials.

Another measure of consistency is the relationships between the latencies to real and pseudo words, within trials. As can be seen in Table 1, children are consistent in reaction times to these two types of words, in spite of the fact that their latency for real words is shorter than their latency for pseudo words.

Table 1

Correlations Between Individual's Scores
On First Trial vs Second Trial

	Grades			
	2nd	3rd	4th	Combined
First Trial x Second Trial (all words)	.87	.62	.81	.86
Real Words x Pseudo Words:				
First Trial	.74	.68	.68	.83
Second Trial	.99	.70	.62	.82

The main results of the study are summarized in Table 2. An analysis of variance was calculated on these data, with the classifications, real vs. pseudo-words, grade levels, and trials. The results of this analysis are:

1. Children show longer latencies in reading pseudo words than real words (F = 70.96, df = 1, 51; $p < .01$).
2. Latencies are longer on the first than on the second trial (F = 28.83, df = 1, 51; $p < .01$).
3. Younger children evidence longer latencies than older children (F = 10.56, df = 2, 51; $p < .01$). This finding is qualified by an interaction between grade levels and word type (F = 8.59, df = 2, 51; $p < .01$). Perusal of the means in Table 2 indicates that second graders show a small difference between real and

pseudo-words, whereas for the third and fourth grades the mean latency for pseudo-words is substantially longer than for real words.

Table 2

Average Response Latencies (in seconds)

	Grades			
	2nd	3rd	4th	Combined
All words	4.51	2.66	2.43	3.20
Real Words	4.10	1.85	1.55	2.50
Pseudo Words	4.86	3.48	3.31	3.90
First Trial	4.74	2.96	2.64	3.45
Second Trail	4.27	2.36	2.22	2.95

Errors in Reading. From the tapes, we judged whether or not the word was read correctly. Of the total of 1728 responses, 1035, or 60% were read correctly. Further, 42% of the pseudo-words and 78% of the real words were correct. In this section, we shall examine the determinants of frequency of errors and the latencies in reading words correctly and incorrectly.

The mean number of errors per subject are given in Table 3. An analysis of variance according to type of word, grade levels and trials yielded two significant main effects and no significant interactions. There are more errors in reading pseudo-words ($F = 104.5$, $df = 1, 51$; $p < .01$) and in the second compared to the third and fourth grades ($F = 7.3$, $df = 2, 51$; $p < .01$).

In addition to the frequency of errors, we investigated the latencies in reading words correctly or incorrectly. The mean latency for correctly read words is 2.08 seconds and for incorrectly read ones, 4.85 seconds. The difference between these means is statistically significant ($t = 64.29$, 181 df, $p<.005$).

Table 3

Average Number of Errors

	Grades			
	2nd	3rd	4th	Combined
All Words	4.6	2.5	2.2	3.1
Real Words	3.4	1.0	0.7	1.7
Pseudo Words	5.7	3.9	3.7	4.4
First Trial	4.6	2.5	2.4	3.2
Second Trial	4.5	2.5	2.1	3.0

The first unadorned analysis indicated that reactions were more rapid to real words than to nonsense ones and that younger children responded more slowly, in general. The subsequent analysis of whether the reading was correct force us to make serious qualifications to the original findings. Pseudo-words are more frequently read incorrectly and younger children make more errors. The latencies are longer to errors than to correct read words. Are the first findings, then, due simply to the differences in frequency of errors? Two subsequent analyses clarify this issue. The latencies for each child were divided into correct and incorrect readings and within this control, the mean latencies to real and pseudo-words were inspected. The results are given in Table 4. Interestingly, the real-pseudo difference holds up only for correctly read words. If the child makes an error, his response is roughly equally slow for both types of words.

Again using the correctness of reading as a control, we inspected age differences in latencies. The initial finding generally holds: older children read words more quickly than younger ones.

Table 4

Average Response Latencies (in seconds) for Words Read Correctly and Words Red Incorrectly.

	Grades			
	2nd	3rd	4th	Combined
All Words:				
Correct	2.66	2.14	1.67	2.08
Incorrect	5.88	3.41	4.62	4.85
Real Words:				
Correct	2.54	1.61	1.24	1.69
Incorrect	5.97	3.82	4.40	5.32
Pseudo Words:				
Correct	2.91	3.25	2.42	2.82
Incorrect	5.83	3.91	4.66	4.68
First Trial:				
Correct	2.80	2.34	1.72	2.21
Incorrect	6.09	4.30	4.87	5.27
Second Trial:				
Correct	2.49	1.94	1.63	1.95
Incorrect	5.67	3.47	4.34	4.71

DISCUSSION

Reading is a private process. The principle barriers to research on the process of reading are the lacks of clear external indices to the process. Eye-movements are one such index, but the measurement of eye movements are extremely complex and fraught with difficulties of interpretation. Frequently, reading is studied by tests of speed of reading or comprehension of what has been read. For our purposes, these measures confound the decoding and information processing subskills. We decided, therefore, to take oral reading as an index which will be common to a series of experiments. The process will be inferred from the ways in which the common index varies with systematic variations in the stimulus materials. Taking such an external manifestation of reading leaves us vulnerable to the contention that reading aloud and silently involves different skills, basically. We doubt that this is true, although a firm answer must itself wait on research which compares the two modes of reading. McLatchy's 1949 study of second graders shows a high association between scores on oral and silent reading tests. (Edfeldt, 1960; Flavell, 1965). We might point out, also, that developmentally, oral precedes silent reading and it is a common observation that when the materials being read are difficult, there is a tendency to mouth or to say the words.

This study was designed to test the validity of response latency as a behavioral index to reading. As such we chose stimulus materials and an age range which should maximize differences among groups. If the index were not sensitive to these extreme variations it would be useless although we do not yet know its potential value in detecting more subtle variations. In general, the results indicate the merit of latency for future research.

Although our strategy was empirical, the results, even at this early stage of research, tempt us to theorize about the process of decoding written words to their language equivalents. One tactic of the reader, and a highly unlikely one, is that the reader starts at the left of the word and sounds out the letters or groups of letters serially. If it happened, this would be a pure instance of decoding from spelling to sound. There is ample evidence that reading does not work this way. In our data, such a decoding process would not yield the differences in latency or errors between real and pseudo-words. Also, we observed that when our subjects read the words aloud, they usually read smoothly with the sounds blended together, even when the response was an error.

Our theory must account for these findings: (1) correct real words are read more quickly than correctly read nonsense materials, and (2) incorrectly read real and nonsense words take equally long. As a first approximation to a theory we hypothesize that speakers of a language store in memory auditory representations of the sounds of their language, English in our case. We say, for example, that a snatch of language we hear and which we do not understand "sounds like English." When the word is exposed to the child he rehearses it. He matches the consequences of this rehearsal to his auditory memory and emits it with varying latencies and correctness, depending on a number of factors.

If he decodes to a familiar group of sounds, there is a close match between his response and his memory and the word is emitted. Correctly read real words are emitted rapidly (an average of 1.69 seconds). The pseudo-words in this experiment were designed to abide by English spelling patterns so that their correct rehearsal would yield English-like sounds (the latencies to these words average 2.14 seconds.) It is tempting to think that the real words are read rapidly because they are familiar to the child or because in their decoding the child makes a judgment about their meaning. While these steps may take place, we prefer the more general formulation of a dimension of familiar sounds in which familiar, previously heard words anchor the dimension at one end.

In the light of this reasoning, consider the relationships between errors and real and pseudo words. Decoding errors, in both cases, move the result toward the unfamiliar end of the sound dimension. The children's equal and long latencies for both categories probably reflect their perplexity with the outcome of the decoding. It may be that the subjects rehearse the sounds, checking to see whether they can bring the sounds into line with their auditory memories. Whether or not the words "look" familiar has little effect, since decoding errors lead to roughly equal latencies for both types of words.

The responses to the word bland are instructive. From our pretest experiences we put the word into the pseudo category because none of the children knew what it meant. Nevertheless, in this study, the mean latency in reading bland was the shortest of all the pseudo words and briefer than some of the meaningful words. The word is made up of some common English sound elements--land, and--so that decoding yielded a familiar sound pattern, but not a familiar word.

If our reasoning is correct, errors in reading which eventuated in real words should have briefer latencies than errors which were finally read as nonsense forms. Such was actually the case. The mean subject latency for errors read as real words was 2.9 seconds, while for errors read as pseudo words it was 4.0 seconds. This effect is clear both on real words and pseudo words. Sign tests of this difference are significant at the .001 level for errors on real words and the .005 level for errors on pseudo words.* These findings imply that when the rehearsal and matching process yields words, the process is terminated more rapidly than when the consequence is unfamiliar to the child.

The process leading to the word read aloud, as we see it now, goes something like this. The child decodes the word into an auditory equivalent (forms an "auditory image"). He checks this image against his auditory memory of words he knows or sound patterns that he is familiar with. The closer the match, the more quickly he says the word. Unfamiliar sound patterns may increase latency by leading to further decoding, rehearsal, matching, or confusion. What are the implications for the age differences in decoding that we have found? We doubt that there is much difference in the familiarity with words or the English sound patterns between seven and nine year olds. Their ability to decode the writing into corresponding sounds, though, is probably vastly different. We find, therefore, more errors at the younger age levels and especially long latencies for errors (unfamiliar sound patterns) by the second graders.

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* The sign tests were run only on subjects with both types of errors. The mean subject latencies for real word type errors only was 2.2 seconds (n=12) and for pseudo word type errors only was 2.6 seconds. (n=9).

We emphasize that our formulation is tentative and subject to change as we accumulate more data. Several directions are visible, however. The next study systematically varies familiarity of sound patterns by presenting words differing in pronouncibility (Underwood and Schultz, 1960). Another idea is to confuse the auditory matching phase by feeding in sound during the exposure-response interval. If possible, we should like to use a list, in another study, in which the spelling to sound correspondences are simple but the resulting sound patterns are unfamiliar. Finally, we would expect more signs of rehearsal such as lip movements, EMG recordings from the larynx, and practice vocalizations (Flavell, 1965) during instances of unfamiliar words.

This formulation of the process of decoding and reading aloud may be summarized by an analogy to playing the piano. Some scales are more difficult to play than others. The mastery of the scales come from mastering the correspondences between written notes and finger movements. Likewise errors are recognizable by their degree of dissonance from a practised and anticipated musical sound pattern.

SUMMARY

This study was designed to test the usefulness of latency in reading words aloud as a response index to the process of reading. Children in the second, third, and fourth grades were shown a randomized list of sixteen words -- eight real and eight pseudo-words. The time they took to give a verbal response to the word after its exposure was measured. The results were as follows:

1. Children are highly consistent in their behavior across trials and between the two types of words within trials.
2. Younger children took longer to read the words than older children.
3. Latencies decrease over trials.
4. It takes longer to read pseudo-words than real words.
5. More errors in reading are made to pseudo than to real words.
6. Younger children make more errors than do older ones.
7. Latencies are longer to words read incorrectly than to ones read correctly.
8. When frequency of errors are controlled, there were no differences in the latencies of real and nonsense words read incorrectly, but for correct responses, real words were read more quickly.

These findings indicate the usefulness of response latency as a measure of reading. The results were interpreted tentatively according to a formulation which analyzes oral reading into the processes of decoding and matching to auditory memory.

APPENDIX A

Latency Means, Latency Standard Deviations, and Percentage of Errors-Both Trials Combined

	Real Words								Pseudo Words							
	Black	Stand	Grand	Bless	Grass	Storm	Check	Charm	Bland	Steck	Chass	Grack	Grerm	Chend	Blerm	Stess
All mean latency	1.51	2.09	2.32	2.75	2.76	2.78	3.05	4.11	2.78	3.72	4.13	4.14	4.25	4.64	4.88	5.39
s.d.	1.39	2.19	2.20	2.73	2.72	3.50	4.10	3.98	3.01	3.13	3.60	3.56	3.42	3.75	4.13	3.98
Percent Errors	9	9	24	31	20	15	35	27	37	63	63	52	93	44	53	62
4th grade																
mean latency	.92	1.00	1.67	1.80	1.91	.92	2.08	3.05	1.26	3.60	4.44	3.32	3.73	3.46	3.72	5.36
s.d.	.25	.35	2.61	1.42	1.61	.35	3.61	3.84	.56	3.83	4.42	4.52	4.65	3.40	3.71	4.71
Percent errors	0	6	16	14	5	3	11	11	34	36	41	52	66	36	47	41
3rd grade																
mean latency	1.12	1.74	1.46	2.46	1.88	2.64	2.36	2.55	2.70	3.17	3.17	3.33	4.14	4.88	4.60	5.09
s.d.	.39	1.41	1.12	2.60	1.11	2.86	3.52	2.67	3.28	2.00	2.49	2.88	3.28	3.86	3.69	3.85
Percent errors	3	6	11	25	11	8	30	11	39	69	66	52	94	36	47	61
2nd grade																
mean latency	2.48	3.52	3.84	4.00	4.50	4.77	4.70	6.74	4.39	4.40	4.79	5.77	4.88	5.58	6.31	5.78
s.d.	2.06	2.92	3.55	3.45	3.69	4.65	4.74	4.05	3.59	3.15	3.65	4.00	3.56	3.86	3.74	3.50
Percent errors	25	16	44	10	44	34	64	58	39	86	83	52	100	61	66	77

APPENDIX B

Analyses of Errors.*

We have classified errors two ways. The first classification is concerned with errors read as real words versus errors read as pseudo words. The second classification is concerned with the part of the word where an error is made.

Table 6 suggests that neither grade nor real vs. pseudo type words affect the proportion of errors given as real or pseudo (with the possible exception of the third grade's response to real words).

Table 6

Classification of Errors

	Real Words Grade				Pseudo Words Grade			
	2nd	3rd	4th	Combined	2nd	3rd	4th	Combined
Number of Errors	126	38	26	190	204	168	133	505
Percent read as real word:	50	37	48	47	47	50	50	49
Percent read as pseudo word:	38	55	38	42	42	37	36	40
Percent omitted:	12	8	15	11	11	13	14	11

Tables 7 and 8 suggest that the determinants of whether word errors are real, pseudo, or omitted have a lot to do with the word in question. In Table 7, the frequency of occurrence in the Thorndike-Lorge Juvenile list is inversely associated with the number of errors and number of

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* We wish to thank Miss Susan Bostwick for her help in preparing this section.

Table 7

Classification of Errors - By Real Words

	Frequency occurrences Per million words*	Number Errors	Number real	Number pseudo	Number omitted
Bless	44.5	34	12	19	3
Charm	58.5	29	3	17	9
Grand	80.6	26	9	12	5
Check	92.8	38	16	11	11
Storm	122.0	5	7	5	
Grass	155.5	22	12	6	4
Black	220+	10	6	4	0
Stand	220+	10	6	3	1
Total		186	69	79	38

*Adapted from Thorndike and Lorge, 1944.

Table 8

Classification of Errors - By Pseudo Words

	# errors	# real	# pseudo	# omitted
Steck	69	50	5	14
Chass	69	46	10	13
Grerm	101	38	56	7
Bland	40	35	5	0
Grack	57	32	17	8
Cherd	48	19	20	9
Steas	65	16	33	16
Blerm	58	11	32	15
Total	507	247	178	82

pseudo-type errors. It is less clearly associated with omissions and real-type errors.

In Table 8, a case could be made for a relationship between the number of real-type errors and the number of letter changes needed to change the pseudo word to a real word. Inspection of the transcript sheds some doubt on this hypothesis.

Our second classification of errors involves breaking words down into three parts: initial (first letters); medial (next three letters); and final (last letter). A word can be categorized as correct (c) or incorrect (i) in any of these three parts. Thus, if the word BLACK were read "BLECK", it would be classified cic. These errors are summarized in Table 9.

Table 9

Errors by Part of Word

	Real Words					Pseudo Words				
		percent					percent			
	#	2nd	3rd	4th	Com	#	2nd	3rd	4th	Com
icc, ici, & iii	21	17.5	5.3	7.7	11.0	67	20.1	17.9	10.5	13.2
cic	34	18.3	13.2	23.1	17.9	125	18.6	26.2	32.8	24.8
cic (vowel only)	22	8.7	15.8	19.3	11.6	85	12.7	23.2	14.9	16.8
cci	5				2.6	21				4.2
iic	14	5.6	15.8	3.9	7.4	45	11.3	5.9	9.0	8.9
cii	72	38.1	42.1	30.4	37.9	110	30.4	13.7	18.7	21.8
omissions	22	11.9	7.9	15.4	11.6	53	11.0	13.1	14.2	10.5
total	190									

A qualitative analysis of the errors themselves may be seen in Table 9. The highest difference between the real and pseudo groups is in the proportion of errors made with the initial consonant. The Pseudo group of words has twice as many of this type of error proportionally than the real group. With this exception and that of the cii group which accounts for 39% of the real group errors and only 22% of the pseudo group errors, there is little difference between the types of errors made on both groups of words.

When the error types are examined by grade level (See Table 3) the following major differences may be noted: 1. That medial errors account for almost 50% of the errors for both the real and pseudo groups and when the medial error is combined with the terminal error the two account for almost two-thirds of all the errors for both groups. 2. With the exception of the 2nd Grade which remains constant, the proportion of cii errors in the real group is almost twice that of the Pseudo group. 3. The 3rd Graders show in almost every case the greatest amount of fluctuation in specific errors types employed. That is, they appear to have two distinct approaches, one for 'real' words and one for 'pseudo' words.

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PRELIMINARY SUMMARY

Studies of Oral Reading[1]

II. Pronounceability

Andrew J. Biemiller and Harry Levin[2]

In our first study, (Levin and Biemiller, 1965), we established that second, third, and fourth graders show longer response latencies to English-like pseudo words than to "real" words. They also show longer response latencies before any word (real or pseudo) read incorrectly, than before any word read correctly. From these observations we developed a tentative theory describing the decoding process. We suggested that the reader develops a tentative hypothesis about a word based on spelling-to-sound correspondences, and matches this hypothesis against some internal criterion of "sounding like English". If the product of decoding meets this criterion, the reader says it (in our test situation) or continues reading (in a normal reading situation).[3]

This study provides a further test of this hypothesis. Twenty-four pseudo words varying in their pronounceability (the ease with which they can be said) were presented to third and fourth graders. From our hypothesis, we would predict that the less pronounceable words would lead to longer latencies, in that the internal products of decoding would sound less like English.

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[1] This study was supported by funds from the Cooperative Research Program, U.S. Office of Education.

[2] We wish to thank Miss Susan Bostwick for her help with this study.

[3] We also expect that in normal reading, the reader is not only matching against a "sounds like English" criterion, but also semantic and syntactic criteria based on the passage being read. This extention is beyond the scope of our present work.

The words used in this study were developed by Eleanor Gibson for her 1962 study. She used the number of errors in written responses to tachistoscopic presentations as her dependent variable. By comparing the mean latencies for each word with the mean number of errors for each word in her study, we obtain some evidence of the validity of using latencies to oral responses as an index of decoding processes. This is particularly important in this study, where the difficulty of responding could be responsible for the latency instead of the difficulty of decoding. A high correlation between mean latency per word and mean number of errors per word would indicate that the latencies are not the result of difficulties in producing a response.

Method

Stimulus Materials. We used twenty-four words drawn from E. Gibson's 1962 study. These words were generated from spelling patterns described by Hockett (1963). Their pronounceability was rated by Gibson using Underwood and Schulz's 1960 rating method. The twenty-four words, with Gibson's ratings and error findings are presented in Appendix A.

Subjects. We tested thirty-six children from the Belle Sherman Elementary school in Ithaca, N.Y.[4] Nine girls and nine boys were randomly selected from one third grade classroom and one fourth grade classroom.[5] Classes were heterogenously organized.

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[4] We are grateful to the staff of the school for their cooperation and assistance.

[5] Non-native speakers of English were eliminated before selection.

Procedure. Each child was informed that he would be shown words on a screen and asked to read them. He was warned that the words had been made up, so ge didn't have to feel badly if he didn't know them.

A lapel microphone was attached and the words projected on a screen three feet from the subject. The projected words were about six inches long by two inches high. After the child responded to a word, there was a two-second interval before presenting the next word. If the child made no response to a word in fifteen seconds, he was asked, "would you like to go on to the next one?" (He invariably did.) Similarly, if the child suggested going on, the next word was displayed.

Results

The subject's responses were analyzed by the method described in Levin and Biemiller, 1965. The response latencies thus obtained were tabulated into mean latencies per word. These are presented in Appendix A. The main results of the study are correlations based on these mean word latencies. These are presented in tables 1 and 2.

Table 1

Correlations (rho) between Mean Response Latencies per Word and Pronounceability Ratings per Word, by Grade and Word Length.

	(N)	Grade		
		3rd	4th	Combined
All words	24	.89	.92	.87
Four and five letters	13	.65	.74	.61
Six, seven, and eight letters	11	.89	.93	.88

Table 2

Correlations (rho) between Mean Response Latencies per Word and Pronounceability Ratings per Word, by Grade and Length.

	(N)	Grade		
		3rd	4th	Combined
All words	24	.79	.80	.86
4 and 5 letter words	13	.36	.08	.27
6, 7, and 8 letter words	11	.75	.84	.79

In both cases, the hypotheses seem confirmed and the strength of the correlation when word length is held constant indicates that word length is not the main factor producing the correlation.

Some unexpected effects of sex on latency appeared in this study. Contrary to the normal pattern in reading studies, the boys in this study showed lower response latencies than the girls. We are currently computing an analysis of variance to test for interactions between this sex effect and the main pronounceability and grade effects.[6] The means whose significance will be tested in this analysis are presented in table 3.

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[6] We shall also be examining sex effects in data from Studies I and II.

Table 3

Mean Latencies in Seconds by Sex, Grade, and Pronounceability.

	Sex		
	Girls	Boys	Combined
All Words	2.90	1.98	2.44
Pronounceability			
Lowest 12 words	2.06	1.58	1.82
Highest 12 words	3.74	2.37	3.05
Grade			
3rd	2.97	2.22	2.60
4th	2.82	1.73	2.28

	Pronounceability	
	Lowest 12	Highest 12
Grade		
3rd	1.93	3.21
4th	1.70	2.85

This table indicates that the sex affect appears in both grades and both pronounceablility conditions. (In checking against another study of ours, we also find that the effect holds up with both female and male E's.)

The mean latency per word was correlated between sexes. This correlation (rho) is .82 for the fourth grade, .72 for the third, and .78 for both grades.

Discussion

This study provides forther confirmation of our theory of decoding, in which the reader makes a tentative guess about graphemic material, based on spelling-to-sound correspondences, and matches this gress against a criterion of "sounding like English". If the word passes the criterion, the reader accepts it and makes an oral response. Less pronounceable words are decoded to less English-like internal representations, causing the reader to re-read or rehearse before making a response.

The high correlation between written errors and latency to oral responses may indicate that a similar decoding to sound-like information is involved in Gibson's task. This correlation also indicates that latency variations in our studies are not a function of the difficulty of making a physical, oral response, but rather of difficulties produced in some central or perceptual process by the visual display. However, Study I. (Levin and Biemiller, 1965) provides some evidence for ruling out perceptual processes by controlling the displays. (Wide variations in response latency were produced by manipulating realness versus pseudoness, while the letters used were the same and in the same positions under both conditions.)

Summary

This is the second in a series of studies using response latency as an index of decoding difficulties in oral reading. Third and fourth graders were shown single pseudo words of varying pronounceability. Their reaction time for oral responses was measured. The main independent variable was shown to correlate highly (rho = .87) with mean response latency over 24 words. The correlation between these variables remained high across grade levels (3rd and 4th) and word length (4-5 and 6-8 letter words). High correlations were also obtained between mean response latency per word and mean errors per word made by adults writing down the words after tachistoscopic presentations.

Appendix A

Table A

Stimulus Words for Study II with Pronounceability Ratings and Ranks, Adult Mean Errors and Ranks, and Mean Latencies in Seconds by Grade and Sex. (Ranks in Parentheses)

	Mean Pronounceability Rating	Number Written Errors	Mean Latency in Seconds 3rd & 4th	Mean Latency in Seconds 3rd	Mean Latency in Seconds 4th
Number of Subjects	165	25	36	18	18
Stimulus Words					
DINK	1.1 (1)	7 (3)	1.3 (2)	1.4 (2)	1.3 (2)
CODC	1.3 (2)	18 (8)	1.2 (1)	1.3 (1)	1.2 (1)
CLATS	1.5 (3.5)	34 (11.5)	1.6 (3.5)	1.7 (4.5)	1.4 (3)
VUNS	1.5 (3.5)	15 (7)	1.9 (10)	2.3 (11)	1.5 (4.5)
GLOX	1.6 (6)	8 (4)	1.8 (7.5)	2.1 (9)	1.5 (4.5)
GRISP	1.6 (6)	12 (5)	1.8 (7.5)	1.9 (6.5)	1.7 (8)
FUNTS	1.6 (6)	6 (2)	2.2 (11)	2.2 (10)	2.2 (12)
SLAND	1.7 (8)	5 (1)	1.6 (3.5)	1.6 (3)	1.7 (8)
SULB	1.9 (9)	30 (10)	2.5 (12.5)	2.4 (12)	2.1 (11)
TILMS	2.2 (10)	28 (9)	2.9 (15.5)	2.6 (14)	2.4 (13.5)
BLORDS	2.3 (11.5)	71 (16)	1.7 (5)	1.7 (4.5)	1.7 (8)
BESKS	2.3 (11.5)	46 (13)	1.8 (7.5)	2.0 (8)	1.7 (8)
FRAMB	2.4 (13)	13 (6)	1.8 (7.5)	1.9 (6.5)	1.7 (8)
PREENT	2.9 (15)	69 (15)	3.0 (18)	3.0 (15.5)	2.4 (13.5)
BLASPS	2.9 (15)	58 (14)	2.9 (15.5)	3.1 (17)	2.6 (16)
GLURCK	2.9 (15)	74 (17)	3.0 (18)	3.3 (18)	2.7 (19)
MRELP	3.0 (17.5)	34 (11.5)	2.8 (14)	3.0 (15.5)	2.6 (16)
QUREZK	3.0 (17.5)	80 (18)	2.5 (12.5)	2.5 (13)	2.6 (16)
KLEAFT	4.2 (19)	88 (20)	3.0 (18)	3.4 (20)	2.7 (19)

Appendix A (continued)

Stimulus Words	Mean Pronounceability Rating	Number Written Errors	Mean Latency in Seconds 3rd & 4th	Mean Latency in Seconds 3rd	Mean Latency in Seconds 4th
TIRPTH	4.5 (20)	83 (19)	3.2 (20)	3.8 (22)	2.7 (19)
PRILTHS	4.6 (21)	97 (22)	3.3 (22)	3.4 (20)	3.2 (22)
TRILFTHS	5.3 (22)	112(23)	3.9 (23)	3.9 (23)	3.9 (23)
SMAWMP	6.2 (23)	122 (24)	3.2 (20.5)	3.4 (20)	3.0 (21)
DRIGHK	6.3 (24)	89 (21)	4.2 (24)	4.2 (24(	4.2 (24)

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PRELIMINARY SUMMARY

Studies of Oral Reading[1]

III. Contingent versus Non-contingent Initial Spelling-to-Sound Correspondences

Harry Levin and Andrew J. Biemiller[2]

This is the third study in our series on oral reading.

English has a complex system of correspondences between language and spelling. The corresponding pronunciations of any vowel and most consonants are contingent upon surrounding graphemes (as well as the location of the cluster in the word). At the level of clusters of letters rather than single letters, English spelling-to-sound correspondences are fairly regular and predictable. (Hockett, 1963)

The competent reader of English has been taught or has induced most of these complex correspondences. For example, he apparently knows that the pronunciation of the letter *c* in the initial position of a word is contingent upon the following letter. However, this implies more complex cognitive processing than would be called for when a consonant with a one-to-one correspondence occurs in the initial position of a word.

We therefore hypothesize that words beginning with letters whose pronunciation is contingent upon following letters will require longer decoding times (measured by response latencies) than will comparable words

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[1] This study was supported by funds from the Cooperative Research Program, U.S. Office of Education.

[2] We wish to thank Miss Susan Bostwick for her help with this study.

starting with letters having one-to-one sound correspondences.

We also hypothesized that words which contain the sound most commonly associated with the variable pronunciation letters would be decoded more rapidly than words in which the other sound occurred. This prediction refers specifically to our test population (second, third, and fourth graders) whose training in school involved large differences in the occurrences of these various pronunciations.

In addition, we predicted that errors in which the reader decoded a variable pronunciation letter as though it had only one pronunciation (e.g. "kent" for "cent") would show lower latencies than other errors.

Method

Experimental Design and Stimulus Materials. In the main treatment classification concerning contingencies, three levels were devised. The first two levels, P_1 and P_2, used words beginning with an initial consonant requiring a contingent letter for pronunciation. P_1 words had the less common pronunciation (e.g. cell), P_2 words had the more common pronunciation (e.g. colt). The third level, C, used words having all the same letters as P_1 words except the first, which was a one-to-one correspondence initial consonant (e.g. dell).

A second treatment classification was defined by the initial letters used. We had four levels: one contrasting hard and soft c's (contingent upon ensuing vowels), one contrasting hard and soft g's (also contingent upon ensuing vowels), and two contrasting present or silent g's and k's respectively (contingent upon ensuing n versus other consonants). Three sets of three words representing P_1, P_2, and C were devised for each of the four letter levels. Where possible, the P_2 and C words were less frequent according to Thorndike and Lorge's (1944) Juvenile list than the associated P_1 words.

Subjects. 54 children from the West Hill Elementary School in Ithaca, N.Y. were tested.[3] 18 fourth grade, 18 third grade, and 18 second grade children were randomly selected from one classroom in each grade. Due to extreme imbalances in the distribution of the sexes and ability groups in the classrooms, no effort was made to balance the grades for sex.

Procedure. Procedure was essentially the same as that outlined in Biemiller and Levin, 1965. The only difference was that the children were told that these were all real words.

Results

The subject's responses were analyzed by the method described in Levin and Biemiller, 1965. The response latencies thus obtained were tabulated into mean latencies per word. The main results of the study are presented in Table 1.[4]

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[3] We wish to thank the principal and teachers for their considerate help and assistance.

[4] This is a preliminary table. We have not yet selected the 18 from each class to be analyzed more carefully.

Table 1

Mean Latencies in Seconds by Contingency, Letter Group, and Grade.

	N	Contingency P_1	P_2	C	Combined
All groups and grades[5]		4.29	3.33	3.15	3.59
Grade					
4th	28	2.49	1.80	1.64	1.97
3rd	20	4.19	3.20	3.06	3.48
2nd	20	6.19	4.98	4.82	5.33
Letter Group[5]					
c-vowel		3.65	2.71	2.27	2.88
g-vowel		3.91	2.99	3.08	3.33
g-consonant		5.19	3.55	3.63	4.12
k-consonant		4.42	4.00	4.05	4.16

We have not yet made an analysis of the variance of these data. However, sign tests of the main hypothesis yield some significant results. See Table 2.

Table 2.

Significance Levels of Numbers of Pairs of Words following Predictions (N = 12).

	$P_1 < P_2$	$P_1 < C$	$P_2 < C$
4th Grade	.005	.10	n.s.
3rd Grade	.005	.10	n.s.
2nd Grade	.10	.005	n.s.

As with our first study, Levin and Biemiller, 1965, the analysis of errors is crucial in determining the nature of the effects. At present, our analysis of errors is very skimpy and we can present only fragments. In general, our error analysis confirms the same pattern shown in Table 1. The number of errors made to P_1 words is much larger than to P_2 and C words.

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[5] All grades weighted equally.

There is no difference in the number of errors made to P_2 and C words. Preliminary latency data indicates that longer latencies are given to P_1 words than to P_2 or C words.

Discussion

Our hypotheses have been partially confirmed. This study needs a considerable further analysis with special reference to words being decoded as pseudo or real words. It may also require a re-run with an additional control group for group P_2, following the same model as group C follows for group P_1.

Summary

This study was designed to test the hypothesis that decoding letters which require contingent letters to make spelling-to-sound correspondences will require more time (indexed as response latency) than letters with one-to-one spelling-to-sound correspondences. We devised thirty-six words in three groups of twelve each to test this theory. Group P_1 included words requiring the use of a contingent letter to decode the initial letter to a sound infrequently associated with the letter (e.g. cell). Group P_2 included words with the same initial letters decoding to the sound most frequently associated with the letter (e.g. Carl). Group C included words which differed from group P_1 only in having initial consonants with one-to-one correspondences (e.g. dell). Results with 54 fourth, third, and second grade students indicate that children find much more difficulty in decoding group P_1 than groups P_2 and C, both in making more errors and in showing longer latencies. Groups P_2 and C do not differ from each other on these indices.

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Sound-Spelling Relationships: A Stratificational Approach.

Daniel Kimball*

Introductory Statement

The paper is an attempt to relate spoken and written English through the construction of underlying forms for particular English words. A corpus of over two thousand words was investigated. An underlying form was set up for each word along with appropriate rules for the generation of the phonemic shape of the spoken word and the traditional spelling of the corresponding written word.

The Model

Underlying forms are constructed on the assumption of different linguistic levels. The paper does not recognize a direct correspondence between the sounds and spellings of English words. Rather it assumes that the sounds and spellings are indirectly related on another linguistic level. The levels considered in the paper are represented in the diagram on the following page.

There are four levels: the lexemic, morphemic, graphemic, and phonemic, as defined below. Sets of rules called realizational rules relate the units of one level to those of another. That is, the application of _X_-o-_Y_-emic realizational rules to units on the _X_-emic level realizes those units as units on the _Y_-emic level. For example, the application of lexomorphemic rules to the vocabulary items of the lexemic level realizes

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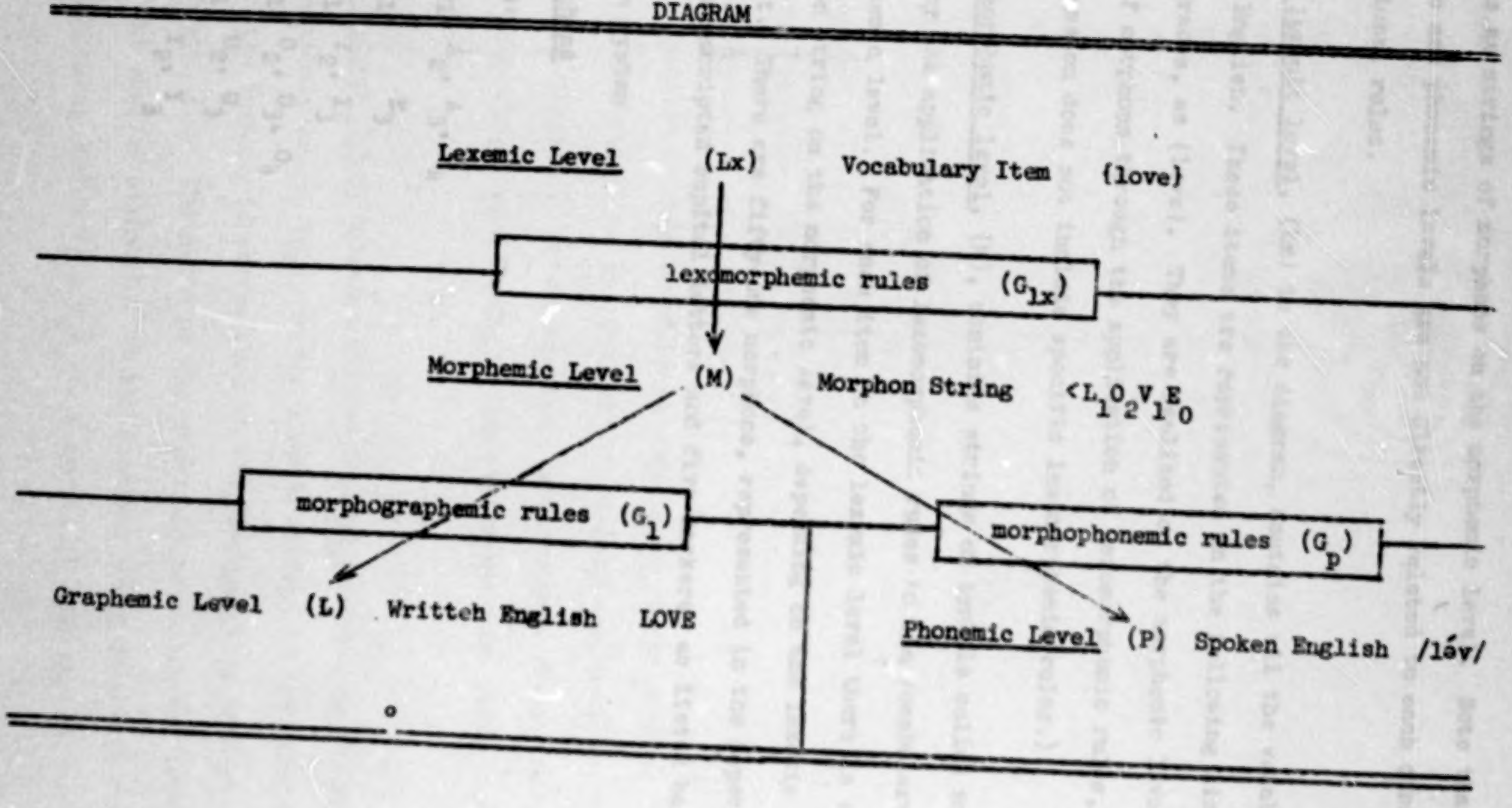
*Study carried out under the direction of Prof. C.F.Hockett.

DIAGRAM


Lexemic Level (Lx) Vocabulary Item {love}
lexomorphemic rules (G_{lx})
Morphemic Level (M) Morphon String $<L_1O_2V_1E_0$
morphographemic rules (G_1)
morphophonemic rules (G_p)
Graphemic Level (L) Writteh English LOVE
Phonemic Level (P) Spoken English /lév/

the items as strings of morphons on the morphemic level. Note that the graphemic and phonemic levels are not directly related to each other by realizational rules.

The lexemic level, (Lx) in the diagram, contains all the vocabulary items of English. These items are represented in the following discussion between braces, as {love}. They are realized on the morphemic level as strings of morphons through the application of lexomorphemic rules, (G_{1x}). (The discussion does not include specific lexomorphemic rules.)

The morphemic level, (M), contains strings of symbols called morphons realized by the application of lexomorphemic rules to the vocabulary items of the lexemic level. For each item on the lexemic level there is at least one morphon string on the morphemic level, depending on the lexemic environment. There are fifty-one morphons, represented in the paper by forty-six subscripted capital letters and five markers, as listed below.

The Morphon System

Letter Morphons

Vowels:

A_1, A_2, A_3, A_4
E_0, E_1, E_3
I_1, I_2, I_3
O_1, O_2, O_3, O_4
U_0, U_1, U_2, U_3
Y_1, Y_2, Y_3

Consonants:

B_1
C_1
D_1
F_1, F_2
G_1
H_0, H_1
J_1
K_1
L_1
M_1
N_1, N_2
P_1
Q_1
R_1
S_1, S_2
T_1, T_2
V_1
W_1
X_1
Z_1

Morphon Markers

Boundary Markers: +, -, C/, space

Stress Marker: <

The markers consist of four boundary markers and a stress marker. The subscripted letter morphons are divided into twenty-one vowel and twenty-five consonant morphons. In the diagram, lexomorphemic rules realize the vocabulary item {love} as a string of one stress and four letter morphons, $<L_1O_2V_1E_0$.

The graphemic level contains written English realized by the application of morphographemic rules, (G_1), to the morphon strings of the morphemic level. Written English is represented in the discussion as strings of capital letters, (L). The units of the graphemic level are the twenty-six letters of the English alphabet. In the diagram, morphographemic rules realize the morphon string $<L_1O_2V_1E_0$ as a string of four capital letters, LOVE.

The phonemic level contains spoken English realized by the application of morphophonemic rules, $(G_p)^{\frown}$, to the morphon strings. Spoken English is represented in the discussion as phonemes, (P). The phonemic system is made up of forty phonemes: two stress phonemes, fourteen vowel phonemes, three semi-vowel phonemes, and twenty-one consonant phonemes, as listed below.

The Phonemic System

Stress

/´/	óarlòck
/`/	fàrewéll

Vowels

/iy/	eat
/i/	it
/ey/	ate
/e/	Etta
/æ/	at
/ɨ/	ballot
/ə/	but
/ay/	bite
/a/	dot
/uw/	root
/u/	foot
/ow/	oat
/o/	war
/ɔ/	caught

Semi-Vowels

/w/	we
/h/	he
/y/	ye

Consonants

/p/	pep
/t/	tat
/ĉ/	itch
/k/	kick
/b/	bib
/d/	did
/ĵ/	judge
/g/	gag
/f/	fife
/θ/	thigh
/s/	sigh
/ŝ/	shy
/v/	vie
/ð/	thy
/z/	zoo
/ẑ/	azure
/m/	mum
/n/	nine
/ŋ/	sing
/l/	lull
/r/	roar

The phonemic system used is a modified Smith-Trager phonemicization of American English. It is hoped that where certain dialects are not accounted for in the morphophonemic rules, an easy translation from the system used to the dialects can be effected. However, the paper does not include such translations. In this the paper agrees with Chomsky that underlying forms are pan-dialectal (1965). Phonemes which bear a low functional load in most dialects have been ignored. In the diagram, morphophonemic rules realize the morphon string $<L_1O_2V_1E_0$ as spoken English, /lə́v/.

Thus, tracing through the model as it is represented in the diagram, one chooses a vocabulary item, {love}. The application of lexomorphemic rules (unspecified) to {love} realizes a string of morphons, $<L_1O_2V_1E_0$. From this string either spoken or written English can be realized. To realize written English one applies morphographemic rules to the morphon string $<L_1O_2V_1E_0$ which realizes LOVE on the graphemic level. To realize spoken English one applies morphophonemic rules to the morphon string $<L_1O_2V_1E_0$ which realizes /lə́v/ on the phonemic level.

To summarize the notation used in the discussion: vocabulary items are written between braces, {love}; morphon strings are written with subscripted capital letters and markers, $<L_1O_2V_1E_0$; written English is written with non-subscripted capital letters, LOVE; and spoken English is written between slant lines, /lə́v/. In addition, words cited without reference to a particular level are italicized, love; the symbol ~ is used to indicate graphemic and/or phonemic alternation such as wife ~ wives; and the symbol -- is used to mean "is realized as", as in {love} -- $<L_1O_2V_1E_0$ meaning "the vocabulary item {love} is realized as the morphon string $<L_1O_2V_1E_0$.

Methodology

The aim of the paper is, then, to set up strings of morphons with appropriate sets of rules which would realize them as either written or spoken English. Two thousand words were randomly selected from the five thousand word list used by Wier in her investigation of grapheme-phoneme correspondences (1964). In addition many other words were investigated in order to achieve as high a degree of accountability as possible. Representative examples of these words are to be found as examples for the individual rules. The two thousand word list has been written as strings of morphons. The rules, both morphographemic and morphophonemic, account for all the words in the list as well as for a great many others.

As each word was examined, morphons and appropriate morphographemic and morphophonemic rules were set up to account for the spelling and pronunciation of the particular word. As the list grew, the inventory of morphons and rules was expanded or, where possible, reduced. Homographs such as tear (n.) and tear (v.) or permit (n.) and permit (v.) were represented by different morphon strings to account for their differences in pronunciation. Similarly, homophones such as bear and bare or air and heir were represented by different morphon strings to account for their differences in spelling.

As can be seen from the rules, the choice of morphons is weighted heavily in favor of the graphemic representation. That is, the morphons chosen to be represented by a particular subscripted capital letter are usually those realized graphemically as that particular letter. In addition it should be noted that the morphographemic rules are considerably less complex than the morphophonemic rules. This may indicate, as is stated below, that written English is very similar to morphophonemic representation.

Examples of how certain morphons were set up follow: The grapheme O occurs in similar graphemic environments in the words love, cove, and move. Since the graphemes L, M, C, and V are always pronounced as /l/, /m/, /k/, and /v/ in these environments, L_1, M_1, C_1, and V_1 were set up as morphons. The grapheme E is never pronounced in these environments and is regarded as a graphemic marker (see below). Therefore E_0 was set up. However the grapheme O in the above environments corresponds to stressed phonemes /ə/, /ow/, and /uw/. Thus it was necessary to set up morphons O_2, O_3, and O_4. (O_1 was set up to account for words like docile.) The three words in question are written as morphon strings $<L_1O_2V_1E_0$, $<C_1O_3V_1E_0$, and $<M_1O_4V_1E_0$. (< is a stress marker discussed below.) Likewise the homographs do (n.) and do (v.) are written as $<D_1O_3$ and $<D_1O_4$.

It was hoped that only a few items would have to be handled on the lexemic level, that is, that a single string of morphons could be set up for most vocabulary items to account for all alternations in phonemic and graphemic realization. Only a few items such as broad ~ breadth would then have needed more than one morphemic representation to generate efficiently all written and spoken English words from a relatively simple set of rules. Items like nate (as in the word innate) need only a single underlying form, $<N_1A_3T_1E_0$, to account for innate, nature, natural, native, nation, national, nationality, and so on. It would seem to be very inefficient to include the broad ~ breadth alternation in the rules since it is unique. On the other hand it seems to be very productive to use $<N_1A_3T_1E_0$ as the underlying form for many words such as those licted above. However, relating words like action and agent or picture and pigment through underlying forms such

as $<A_3G_1$ or $<P_1I_1G_1$, as has been done in the paper, seems to be of marginal productivity. There seems to be a continuum of efficiency.

As a general rule, while the corpus was examined, it was felt that if it were necessary to set up more than one morphon or rule of very low productivity in order to account for an alternation, different underlying forms would be constructed. For example, two underlying forms were set up for {five} in order to account for five and fifty becouse of the realizations of I_3, V_1, and E_0 if a single base $<F_1I_3V_1E_0$ were used. (Compare with nine~ ninety.)

There seems to be no simple rule of thumb as to when the rules should be changed or two underlying forms constructed; that is, when to use lexomorphemic rules or morphographemic and morphophonemic rules. It appears now that it may be, as Chomsky has suggested, just as efficient to use traditional orthography as underlying forms for spoken English (1964: 4,6). However the orthography should be augmented with subscripts and a few other symbols to indicate regular sound-to-spelling correspondences.

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SUMMARY

The major initial effort of Project Literacy was to bring together researchers and educators from a variety of disciplines to plan research on reading which, when taken as a whole, would provide more substantial results than any single study. After compiling a roster of imaginative and productive scientists whose work was conceivably relevant to understanding the process of reading, a selected number were invited to one of four research planning conferences. With the intent of attracting new talent to research in this area they were asked to bring an able graduate student to the sessions. Approximately 70 researchers from 25 different universities and research centers have attended these conferences.

The high scientific caliber of the research plans generated interest among the participants. In many instances collaborative research grew out of the discussion and graduate students were inspired to undertake research which meshed with the work in other laboratories. Perhaps the most important consequence was that the participants developed loyalties to the conception of Project Literacy and are prepared to devote their efforts to both basic and applied research germane to literacy.

To maintain communication among affiliates of Project Literacy, Project Literacy Reports was issued at irregular intervals. These have a circulation of 500 copies. They have been useful not only to members of the Project Literacy consortium but have been a source of research ideas to other people.

On the basis of the conferences and subsequent informal meetings, about ten research proposals have been submitted to the Cooperative Research Program, and at least 10 more are being prepared.

To allow for a continual interplay between laboratory and classroom, an experimental first grade was organized in Ithaca. The acquisition of initial literacy was intensively observed by a linguist and a psychologist, and the implementation of new curricular materials and methods were studied. A number of topics for experimental investigation were isolated and will be carried out by members of the Project Literacy Consortium. In addition, the researchers' observations have provided a bases for curriculum development in the first grade.

Also at Cornell, work was completed extending the previous studies of spelling-to-sound correspondences by Hockett and more recently by Weir. In the search for a morphon representation of English from which by obligatory rewrite rules, either spoken or written English can be generated, a method for predicting the location of stress in any spoken word has been developed. A corpus of over 2000 words was investigated. An underlying form was set up for each word along with appropriate rules for the generation of the phonemic shape of the spoken word and the traditional spelling of the corresponding written word. The results of this study will be used to program reading instructional materials for first grade children.

Three studies of oral reading were conducted with second, third and fourth grade school children. The first study established that response latency is higher to pseudo-words than to real words and to words read incorrectly. The second showed that response latency is highly correlated with pronounceability. The third showed that response latency and errors are higher when the corresponding sounds of the initial letter in a word are contingent on the second letter, than when the sound correspondence is regular. As a result of the investigations, we hypothesize that the reader develops tentative guesses about words based on spelling-to-sound correspondences, and matches these guesses against a criterion of sounding-like-English. If the match is satisfactory, the reader continues reading.